## PART III. STUDY RESULTS

## CHAPTER 4:
## OVERVIEW OF STUDY RESULTS

### 4.1 Survey Response Rates and Profile of Sample Respondents

This first section of the chapter presents a profile of the respondents who participated in our study. First, we detail the response rate for each of the survey approaches (mail/in-person follow-up and mail-only). We then present demographic profiles of the respondents and compare their socioeconomic characteristics to those of the general public in the Greater Houston-Galveston Area (as depicted in the 1990 census results).

As discussed in Chapter 3, two different samples were selected: one that received a questionnaire in the mail and was invited to participate in an in-person interview (mail/in-person follow-up), and another that received only a questionnaire to be returned by mail (mail-only). The size of the mail/in-person follow-up sample was 750 households, and the size of the mail-only sample was 1000 households. In both cases, a substantial portion of the questionnaires were returned immediately by the post office as undeliverable (slightly more than 10 percent).

For both the mail/in-person follow-up and mail-only surveys, we made a considerable effort to increase our participation rate with follow-up phone calls and mailings. During these efforts, we examined the reasons why some of the people in the sample did not respond to our request to participate in the study. These are summarized in Tables 4.1 and 4.2. The tables also indicate the number of subjects in each sample that were selected to receive the videotape as part of our investigation of the effect of providing respondents with additional information.

In Table 4.1 the response rates for the mail/in-person follow-up sample are summarized. By the end of the study, 234 interviews were completed. Of the 750 questionnaires sent out, 181 were either (1) never received by the subjects, or (2) received by subjects who chose not to participate and could not be contacted by us (usually due to a disconnected phone or a wrong number). If we remove these 181 subjects from the mail/in-person follow-up sample, the response rate among the remaining subjects was 41 percent (234/(750-181)).

**Table 4.1**       **Response Rates for Mail/In-Person Follow-up Sample (by Interview Location)**

|  | Baytown | | | Mainland | | | Northwest | | | Total |
|  | V | NV | Subtotal | V | NV | Subtotal | V | NV | Subtotal | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Participants** | 37 | 32 | 69 | 37 | 42 | 79 | 41 | 45 | 86 | 234 |
| **Nonparticipants** | | | | | | | | | | |
| Confirmed Received: | | | | | | | | | | |
| Not interested | 7 | 9 | 16 | 4 | 3 | 7 | 5 | 8 | 13 | 36 |
| Sick/too old/family | 5 | 2 | 7 | 6 | 4 | 10 | 3 | 3 | 6 | 23 |
| Said "May come" | 14 | 13 | 27 | 9 | 3 | 12 | 12 | 16 | 28 | 67 |
| Returned by Mail | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 3 | 3 |
| Other | 9 | 0 | 9 | 8 | 1 | 9 | 3 | 2 | 5 | 23 |
| Subtotal: | 35 | 24 | 59 | 27 | 11 | 38 | 25 | 30 | 55 | 152 |
| Status Unknown: | | | | | | | | | | |
| Phone message | 12 | 21 | 33 | 6 | 4 | 10 | 25 | 20 | 45 | 88 |
| No answer | 7 | 6 | 13 | 3 | 2 | 5 | 11 | 7 | 18 | 36 |
| Other | 4 | 3 | 7 | 4 | 2 | 6 | 6 | 2 | 8 | 21 |
| Subtotal: | 23 | 30 | 53 | 13 | 8 | 21 | 42 | 29 | 71 | 145 |
| "Did not receive" | | | | | | | | | | |
| Assumed untrue[13] | 4 | 8 | 12 | 1 | 10 | 11 | 1 | 5 | 6 | 29 |
| Other Reasons | | | | | | | | | | |
| Spanish speaking | 2 | 3 | 5 | 1 | 0 | 1 | 3 | 0 | 3 | 9 |
| Subtotal: | 6 | 11 | 17 | 2 | 10 | 12 | 4 | 5 | 9 | 38 |
| Total Nonparticipants: | 64 | 65 | 129 | 42 | 29 | 71 | 71 | 64 | 135 | 335 |
| Total included in sample: | 101 | 97 | 198 | 80 | 70 | 150 | 112 | 109 | 221 | 569 |
| | | | | | | | | | | |
| **Removed from sample** | | | | | | | | | | |
| Returned Undeliverable | 7 | 3 | 10 | 14 | 9 | 23 | 14 | 22 | 36 | 69 |
| Phone Disconnected | 11 | 15 | 26 | 5 | 10 | 15 | 18 | 13 | 31 | 72 |
| "Did not receive" | | | | | | | | | | |
| Assumed true | 4 | 9 | 13 | 1 | 10 | 11 | 2 | 4 | 6 | 30 |
| Deceased | 2 | 1 | 3 | 0 | 2 | 2 | 3 | 2 | 5 | 10 |
| Total excluded from sample: | 24 | 28 | 52 | 20 | 31 | 51 | 37 | 41 | 78 | 181 |
| | | | | | | | | | | |
| **Total Sample:** | **125** | **125** | **250** | **100** | **101** | **201** | **149** | **150** | **299** | **750** |

During the follow-up phone calls 67 subjects indicated that they had received the questionnaire and might participate, but did not complete the in-person follow-up interview. Thirty-six subjects stated directly that they were not interested in participating, and another 23 cited illness, old age, and family obligations as reasons that they would not complete the interview. Some subjects mailed in their survey rather than come in for an interview, and nine said they did not

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[13]  When contacted by phone, 59 persons in the sample reported that they had not received the questionnaire package. We confirmed their names and addresses with them, and their mailings were not returned to us by the postal service. We took a conservative position by assuming that half of these were truly not received by the respondents while the other half were probably just thrown away.

come in because they only spoke Spanish. Although we had Spanish versions of our survey questionnaire and interviewers capable of conducting the interviews in Spanish (two such questionnaires were actually completed), language was still seen as a barrier by the potential respondents in these cases. We believe an additional 150 subjects received the questionnaire, but we were unable to contact them, and they did not complete the interview. We include them in our count of nonparticipants.

Table 4.1 also shows a breakdown for each of these categories by location of the interviews. Two hundred fifty questionnaires were sent to households inviting them to come to our interview site at the Baytown Community Center, 201 were likewise sent to households around our site at Mall of the Mainland, and 299 were sent to households around Northwest Mall. The response rates by location, excluding those who we believe did not receive the invitation to participate, were 35 percent at Baytown, 53 percent at Mall of the Mainland, and 40 percent at the Northwest Mall. From a casual look at the response rates for those individuals receiving the video and those who did not, it does not appear that receiving a video had an effect on the household's decision to participate in the study, either in the mail/in-person follow-up sample (Table 4.1) or in the mail-only sample (Table 4.2).

The mail-only sample resulted in the return of 393 completed questionnaires. Two hundred and three households were removed from this sample because we determined that they did not receive the questionnaire. Thus, our response rate for the mail-only sample was 49 percent.

| Table 4.2 | Response Rates for Mail-Only Sample | | |
|---|---|---|---|
| | Video | No Video | Total |
| **Participants** | 186 | 207 | 393 |
| **Nonparticipants** | 212 | 193 | 405 |
| Total included in sample: | 398 | 400 | 798 |
| Removed from sample | | | |
| Returned in mail | 63 | 66 | 129 |
| Phone number disconnected | | | |
| (or wrong number) | 38 | 33 | 71 |
| Deceased | 1 | 1 | 2 |
| **Total excluded from sample:** | 102 | 100 | 202 |
| **Total of Totals:** | **500** | **500** | **1000** |

In order to determine how representative our samples actually were of households in our study area, we also compared the two samples with census data for the Greater Houston-Galveston

Area. Table 4.3 presents the demographic characteristics of the respondents in both samples and the population of the Greater Houston-Galveston Area. The results indicate that our survey participants were on average older, more frequently male, from smaller households, more highly educated, wealthier, and more frequently Caucasian than the general population (as reflected in the 1990 census). Comparing respondents in the mail/in-person follow-up survey at different interview sites, the group participating at the Northwest Mall site was the most highly educated and had the highest housing costs. They were not, however, the wealthiest. Eighty-six percent of this Northwest Mall group were Caucasian. For the mail/in-person follow-up sample as a whole, though, these characteristics are balanced somewhat by the results obtained from the two other sites. For example, the demographic characteristics of respondents who came to the Mall of the Mainland site compare very well with the 1990 census data in terms of household size, number of children in the household, educational attainment, and the percent of the respondents who were African-American.

Most distinctly underrepresented in our samples are women, Hispanics, and people with an education level only up through high school. Our sample was drawn from the population with listed telephone service; this suggests at least one potential source for the observed bias.

**Table 4.3**     **Comparison of In-Person and Mail-Only Survey Respondents With Houston Area Profile (1990 U.S.Census)**

| | In-Person Sub-Samples: | | | In-Person Whole Sample | Mail-Only Whole Sample | Houston-Galveston Area Profile |
| --- | --- | --- | --- | --- | --- | --- |
| | North-West | Main-land | Bay-Town | | | |
| Number of Respondents | 86 | 79 | 69 | 234 | 393 | 3.3 million |
| Mean Age of Respondent | 47.1 | 49.7 | 45.8 | 47.6 | 48.3 | 40.7 |
| % Male/% Female | 64/36 | 66/34 | 70/30 | 66/34 | 68/32 | 50/50 |
| Mean Household Size | 2.00 | 2.75 | 2.83 | 2.49 | 2.69 | 2.75 |
| Mean Number of Children in Household | 0.29 | 0.77 | 0.81 | 0.60 | 0.63 | 0.785 |
| Education of Respondent | | | | | | |
| % through High School only | 15.1 | 32.9 | 27.9 | 24.90 | 21.0 | 49.3 |
| % with some college only | 30.2 | 44.3 | 35.3 | 36.50 | 29.5 | 26.6 |
| % completed college/more | 54.7 | 22.8 | 36.8 | 38.60 | 49.5 | 24.0 |
| Mean Income | $54,944 | $50,896 | $60,092 | $55,095 | $54,817 | $41,064 |
| Median Income | $44,695 | $44,695 | $54,699 | $44,695 | $44,695 | N/A |
| % Homeowners/renters | 59/41 | 86/14 | 90/10 | 77/23 | 84/16 | 54/46 |
| Mean House Value (Homeowners Only) | $70,743 | $55,188 | $68,055 | $64,704 | $82,279 | N/A |
| Mean Rent (Renters Only) | $539 | $350 | $315 | $471 | $416 | N/A |
| Racial Breakdown | | | | | | |
| % Caucasian | 85.9 | 77.2 | 79.7 | 81.1 | 84.3 | 56.87 |
| % African-American | 4.7 | 17.7 | 11.6 | 11.2 | 6.5 | 18.2 |
| % Hispanic | 7.1 | 5.1 | 7.2 | 6.4 | 4.5 | 21.0 |

**4.2 Respondents' Attitudes Toward the Environment and Their Recreational Uses of Galveston Bay**

We asked respondents in both the mail/in-person follow-up and mail-only surveys to indicate their first and second priorities across a selection of social, economic, and environmental issues in the Greater Houston-Galveston Area. Table 4.4 presents the results for the mail/in-person follow-up and mail-only samples combined (i.e., the total, pooled sample).[14] Nearly 40 percent of the respondents indicated that crime was their first priority, followed by unemployment (20 percent), and the quality of public schools (17 percent). Only 10 percent of the respondents indicated that environmental issues were their first priority. When asked for their second priority, 24 percent of the respondents indicated the quality of the public schools, followed by crime (22 percent) and pollution (19 percent). Combining respondents' answers to both first- and second-place priorities, we can see that crime was the top priority, mentioned as first or second priority by 60 percent of the respondents, followed by the quality of the public schools and the rate of unemployment. These results suggest that environmental quality is not the top policy concern of most people in the study area, though it is important to almost 30 percent of all respondents.

**Table 4.4    Social, Economic and Environmental Issues in the Greater Houston-Galveston Area:  Priorities for Action (Unweighted, Pooled Sample)**

| Issue | % of Respondents Choosing as 1st Priority | % of Respondents Choosing as 2nd Priority | % of Respondents Choosing as 1st or 2nd Priority |
|---|---|---|---|
| Unemployment | 20.4 | 12.9 | 33.4 |
| Poor Economic Performance | 7.2 | 8.8 | 16.0 |
| The AIDS Epidemic | 3.0 | 4.3 | 7.4 |
| Crime | 37.5 | 22.6 | 60.0 |
| The Quality of the Public Schools | 16.6 | 23.6 | 40.0 |
| Pollution | 10.0 | 19.0 | 29.0 |
| Traffic Congestion in and around Cities | 1.0 | 4.0 | 5.0 |
| Other | 2.7 | 2.1 | 4.8 |
| Not Sure/No Opinion | 1.6 | 2.7 | 4.4 |

[14]    For all the results that are presented in this first section of the chapter, respondents from the in-person and mail-only surveys have been combined without any adjustments or corrections for sample selection bias. In Chapter 6 we present results of multivariate statistical analyses that enable us to better extrapolate our findings to the general population in the Greater Houston-Galveston area.

Next, we focused on the environmental problems of Galveston Bay and asked similar questions about priorities for action. Table 4.5 gives the results for the pooled mail/in-person follow-up and mail-only samples. Nearly 50 percent of the respondents felt that the discharge of refinery and other industrial wastes was the most important problem facing the bay; 21 percent listed it as their second priority. Overall, the discharge of refinery and other industrial wastes was selected as the first or second priority by 70 percent of the respondents. Discharge of wastewater from cities around the bay and oil and chemical spills from shipping in the bay are nearly tied for second place. Forty percent of the respondents selected "discharge of wastewater from cities" as either their first or second priority for action, and 38 percent selected "oil and chemical spills from shipping" as their first or second priority for action.

**Table 4.5    Respondents' Perceptions of the Importance of Environmental Problems Facing Galveston Bay  (Unweighted, Pooled Sample)**

|  | % of Respondents Choosing as 1st Priority | % of Respondents Choosing as 2nd Priority | % of Respondents Choosing as 1st or 2nd Priority |
|---|---|---|---|
| Agricultural Run-off | 3.8 | 8.5 | 12.6 |
| Urban Wastewater | 17.9 | 22.6 | 40.6 |
| Refinery and other Industrial Waste | 48.5 | 20.7 | 69.2 |
| Landfill Seepage | 2.4 | 6.4 | 8.4 |
| Storm Water Runoff | 3.0 | 2.7 | 5.8 |
| Oil and Chemical Spills | 14.4 | 22.8 | 37.2 |
| Beach Litter and debris | 2.9 | 8.8 | 11.6 |
| Other | 3.0 | 2.4 | 5.4 |
| Not Sure/No Opinion | 4.1 | 5.1 | 9.2 |

The responses to additional questions indicated that for the pooled samples--both mail-only and mail/in-person follow-up taken together--about 10 percent of the respondents identified themselves as active environmentalists, and about 75 percent felt they were sympathetic to environmental causes. Only 4 percent were unsympathetic to environmental causes. The rest answered either that they did not know or they were not sure. Only 12 percent of the pooled respondents indicated that they belonged to environmental organizations. Forty percent said that they donate more than $100 per year to nonprofit organizations other than religious groups.

When we asked whether their households had an impact on the water quality of Galveston Bay, 34 percent of the respondents answered yes. Of those, 40 percent said they had less of an impact than other households, 3 percent said they had more of an impact, and the rest said that they thought their impact was about the same as that of other households. In the in-person interviews we were able to probe further about the kinds of impacts our respondents thought their households had on the water quality of Galveston Bay. Without prompting, of those who acknowledged having an impact on the water quality of the bay, 53 percent mentioned municipal wastewater discharge, 25 percent mentioned runoff of fertilizers and pesticides, and 10 percent mentioned automobile discharges finding their way into the bay. Several respondents indicated more than one of these impacts, or offered others.

We also asked questions that would help us understand our respondents' attitudes toward actions that could be taken to improve the water quality and environmental resources of Galveston Bay (i.e., the components of the management plan). For example, 57 percent felt there should be a management plan for Galveston Bay and felt some responsibility for paying for it. Thirty-eight percent said they felt there should be a management plan for Galveston Bay but did not really feel that it was their responsibility to pay for it. Five percent said that they did not think there should be a management plan for Galveston Bay, and 32 people did not answer this question.

One question asked respondents to indicate on a scale from 1 to 10, how likely they thought it was that the management plan described in the questionnaire would actually result in improved environmental quality, where a score of 1 meant "not very likely" and 10 meant "very likely." Twenty-nine percent of our pooled sample gave scores of 5 or less; 71 percent gave scores of 6 or more. Fourteen percent gave a score of 10 for this question (27 people did not give a score at all). These results suggest that the majority of respondents believe that the management plan described in the questionnaire would actually result in improved environmental quality for Galveston Bay.

Another question probed further about respondents' attitudes toward financially supporting a plan for the bay. We asked respondents to indicate how responsible they felt about providing financial support for the plan, where a score of 1 meant "not very responsible" and a score of 10 meant "very responsible." Sixty-eight percent gave scores of 5 or less, 32 percent gave scores of 6 or more (62 people did not respond to this question). Thus it appears that although the participants in our sample support the idea of a management plan and generally believe that it would be effective, many do not feel very much responsibility for supporting it financially. Most of these persons felt that the damage to the environment of the bay had been primarily caused by commercial activity on the bay and that those who had caused the damage should pay for the plan.

## 4.3   Respondents' Recreational Uses of Galveston Bay

In our study we asked questions about how people in the Greater Houston-Galveston Area use Galveston Bay for recreation, and this section describes what we found. The format and design

of the in-person interviews allowed us to ask more detailed questions about how people use the bay, especially about their boating and fishing experiences, but we reached a larger number of people with our mail-only survey, and covered more of the Greater Houston-Galveston Area. We feel that our mail-only sample is more representative of the population in the study region with regard to uses of the bay, and therefore in the following discussion we will focus largely on the data from the mail-only sample.[15]

To illustrate this discrepancy, as well as show use rates for fishing and boating in general, Table 4.6 gives the mean number of days spent fishing from a pier and from a boat, and the number of days spent boating (without fishing), from each of the samples and from the two samples combined. In addition, the percent of the sample that spent zero days engaged in each activity is given, along with the percent that spent more than ten person-days per household engaged in each activity. Clearly, the respondents from the mail/in-person follow-up survey had higher recreational use rates overall, both in terms of the percentage of the respondents indicating some use of the bay in the past 12 months and in intensity of use.

**Table 4.6    Number of Person-Days Per Year Spent Fishing and Boating on Galveston Bay Per Household**

|  | Mail/In-Person follow-up | | | Mail-Only | | | Pooled Samples | | |
|---|---|---|---|---|---|---|---|---|---|
|  | Mean days | Non-users (%) | 10+ days (%) | Mean days | Non-Users (%) | 10+ days (%) | Mean days | Non-users (%) | 10+ days (%) |
| Fishing/Pier | 5.5 | 72.2 | 12.4 | 2.3 | 81.7 | 6.9 | 3.5 | 78.1 | 8.9 |
| Fishing/Boat | 4.4 | 78.6 | 14.1 | 2.7 | 86.8 | 6.9 | 3.4 | 83.7 | 9.6 |
| Boating Only | 4.4 | 75.6 | 13.7 | 1.5 | 89.8 | 5.3 | 2.6 | 84.5 | 9.5 |
| Any Boating or Fishing | 14.4 | 57.3 | 26.1 | 6.5 | 73.8 | 15.5 | 9.5 | 67.2 | 19.6 |

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[15]    The subsamples of two of our three sites for the mail/in-person follow-up interviews were drawn from populations living close to the bay. The frequency of bay-related recreational activities reported by these respondents were significantly higher than the frequencies reported by the mail-only respondents. Since the mail-only sample provided better geographical representation, we have used the results from that sample to extrapolate recreational usage rates to the rest of the population.

In addition to boating and fishing on Galveston Bay, we asked our respondents how many times in the past 12 months they had used the bay for picnicking, bird watching, hiking and camping, and hunting and trapping.[16] We also asked how much seafood from the bay the respondent's household ate on a monthly basis. Table 4.7 shows, for the mail-only sample, the intensity of bay use for different categories of users.

These data in Table 4.7 show that a small percentage of our mail-only sample used the bay extensively as a site for recreational fishing, boating, picnicking, bird-watching, or hiking. Approximately 19 percent of the sample respondents used the bay for such recreational purposes more than ten times per year. About 44 percent of the sample used the bay for some recreational purpose at least once a year. Approximately 26 percent of the population of the five-county area used the bay for recreational boating and fishing at least once a year.

Most people in our sample do eat seafood from the bay a few times a year, and in this sense have a direct interest in cleaning up the bay. But only about 10 percent reported eating seafood from the bay as often as three times a month.

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[16]    We also asked participants about their use of the beaches, but it became clear to us as our study progressed that people were not distinguishing trips taken to the beaches on Galveston Island on the Gulf of Mexico from trips to beaches on Galveston Bay. As a result, we have omitted this category of use from our analysis.

**Table 4.7    Demographics of Galveston Bay Recreational Use (Unweighted, Mail-Only)**

| Demographic Characteristic | N | Picnicking, Hiking, and Bird-Watching (days/year) | | | Hunting and Trapping (days/year) | | | Seafood Consumption (meals/month) | | | Fishing from a Pier or Dike (days/year) | | | Fishing from a Boat (days/year) | | | Boating Without Fishing (days/year) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0 (%) | <10 (%) | 10+ (%) | 0 (%) | <10 (%) | 10+ (%) | 0 (%) | <10 (%) | 10+ (%) | 0 (%) | <10 (%) | 10+ (%) | 0 (%) | 10 (%) | 10+ (%) | 0 (%) | <10 (%) | 10+ (%) |
| **Race/Ethnic Group** | | | | | | | | | | | | | | | | | | | |
| Caucasian | 321 | 70 | 26 | 4 | 97 | 3 | 0 | 31 | 67 | 2 | 83 | 11 | 6 | 85 | 7 | 8 | 89 | 5 | 5 |
| African-American | 25 | 64 | 24 | 12 | 100 | 0 | 0 | 32 | 56 | 12 | 80 | 4 | 16 | 92 | 8 | 0 | 88 | 8 | 4 |
| Hispanic | 17 | 59 | 35 | 6 | 100 | 0 | 0 | 29 | 65 | 6 | 82 | 18 | 0 | 94 | 0 | 6 | 94 | 0 | 6 |
| Asian/ Asian-American | 7 | 57 | 43 | 0 | 100 | 0 | 0 | 28 | 57 | 14 | 71 | 29 | 0 | 100 | 0 | 0 | 100 | 0 | 0 |
| Other | 23 | 74 | 22 | 4 | 96 | 4 | 0 | 39 | 57 | 4 | 74 | 9 | 17 | 92 | 4 | 4 | 91 | 5 | 4 |
| **Tenure** | | | | | | | | | | | | | | | | | | | |
| Homeowner | 322 | 69 | 27 | 4 | 98 | 2 | 0 | 31 | 66 | 3 | 82 | 11 | 7 | 86 | 7 | 7 | 90 | 5 | 5 |
| Renter | 59 | 68 | 24 | 8 | 93 | 7 | 0 | 32 | 65 | 4 | 76 | 15 | 9 | 90 | 2 | 8 | 87 | 5 | 8 |

**Table 4.7    Demographics of Galveston Bay Recreational Use (Unweighted, Mail-Only) (Continued)**

| Demographic Characteristic | N | Picnicking, Hiking, and Bird-Watching (days/year) | | | Hunting and Trapping (days/year) | | | Seafood Consumption (meals/month) | | | Fishing from a Pier or Dike (days/year) | | | Fishing from a Boat (days/year) | | | Boating Without Fishing (days/year) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0 (%) | <10 (%) | 10+ (%) | 0 (%) | <10 (%) | 10+ (%) | 0 (%) | <10 (%) | 10+ (%) | 0 (%) | <10 (%) | 10+ (%) | 0 (%) | 10 (%) | 10+ (%) | 0 (%) | <10 (%) | 10+ (%) |
| **Income** | | | | | | | | | | | | | | | | | | | |
| <$20,000/year | 47 | 60 | 34 | 6 | 98 | 2 | 0 | 49 | 45 | 6 | 77 | 13 | 10 | 89 | 7 | 4 | 90 | 6 | 4 |
| $20,000 to $40,000/year | 88 | 69 | 25 | 6 | 94 | 6 | 0 | 27 | 69 | 4 | 79 | 14 | 7 | 89 | 2 | 9 | 89 | 3 | 8 |
| >$40,000/year | 258 | 71 | 25 | 4 | 98 | 2 | 0 | 30 | 67 | 3 | 83 | 11 | 6 | 86 | 8 | 6 | 90 | 5 | 5 |
| **Education Level** | | | | | | | | | | | | | | | | | | | |
| Grade School (1-8) | 4 | 100 | 0 | 0 | 100 | 0 | 0 | 75 | 25 | 0 | 100 | 0 | 0 | 100 | 0 | 0 | 100 | 0 | 0 |
| Some High School (9-11) | 16 | 81 | 19 | 0 | 100 | 0 | 0 | 63 | 37 | 0 | 87 | 13 | 0 | 100 | 0 | 0 | 94 | 6 | 0 |
| High School Diploma (12) | 62 | 64 | 26 | 10 | 93 | 5 | 2 | 27 | 69 | 4 | 76 | 13 | 11 | 79 | 8 | 13 | 90 | 5 | 5 |
| Some College (13-15) | 115 | 65 | 33 | 2 | 98 | 2 | 0 | 32 | 63 | 5 | 76 | 17 | 7 | 85 | 9 | 6 | 88 | 7 | 5 |
| College Degree (16) | 113 | 72 | 22 | 6 | 96 | 4 | 0 | 32 | 65 | 3 | 82 | 10 | 8 | 90 | 5 | 5 | 90 | 4 | 6 |
| Postgraduate (17+) | 80 | 69 | 26 | 5 | 100 | 0 | 0 | 26 | 73 | 1 | 90 | 6 | 4 | 86 | 6 | 8 | 90 | 4 | 6 |

## 4.4    Description of Respondent Voting Patterns for Galveston Bay Hypothetical Management Plan

### 4.4.1 Introduction

This section of Chapter 4 presents several analyses of the raw (unweighted) responses to the referendum questions from both questionnaire types. We illustrate here how the pattern of responses varies with specific characteristics of the sample respondents. For all the figures in this section, the four prices offered to respondents in the referendum question are shown on the horizontal axis. On the vertical axis is the percent of the sample that voted yes at each price. First, figures displaying the voting patterns of respondents with different income and education levels are presented, and then a comparison of users and nonusers' votes is shown. Next, we examine the treatments in our study design, first comparing responses to the referendum question in the mail-only and mail/in-person follow-up questionnaires, and then those for the video and nonvideo watchers. It is also important to note how different assumptions made to accommodate the high incidence of "not sure" responses in the mail-only questionnaire affect our results. Finally, we show the effect of weighting the raw data to adjust for the sample selection bias on the results. We again use the pooled data, both raw and weighted, from the two surveys.

In the raw data for both the mail-only and the mail/in-person follow-up questionnaires, respondents were distributed almost equally over the referendum price groupings ($5, $10, $15, and $30). In a random sample, the proportion of the group that would vote for the plan represents an estimate of the proportion of the population willing to pay the given amount. We expect smaller proportions of the population to be willing to pay for the plan at the higher prices.

## 4.4.2 Population Characteristics and Voting Patterns

It is interesting to examine the responses to the valuation question given by different groups in the population. Three characteristics by which we have grouped respondents are household income level, educational attainment, and whether the respondent uses the bay. In Figure 4.1, we have pooled the mail-only and mail/in-person follow-up sample data and divided this data into income categories that each represent approximately one fourth of the population of the Greater Houston-Galveston Area. For the mail/in-person follow-up respondents, we use their answers to the first referendum question only. The proportions voting for the management plan (a "yes" vote) at each price are lowest for the lowest income category (less than $20,000 per year). No clear trend emerges from these raw vote profiles for the higher income categories, however.

**Figure 4.1:**
**Percent of Respondents Voting "Yes" at Price Offered**
**(by Income Groups, Pooled data)**
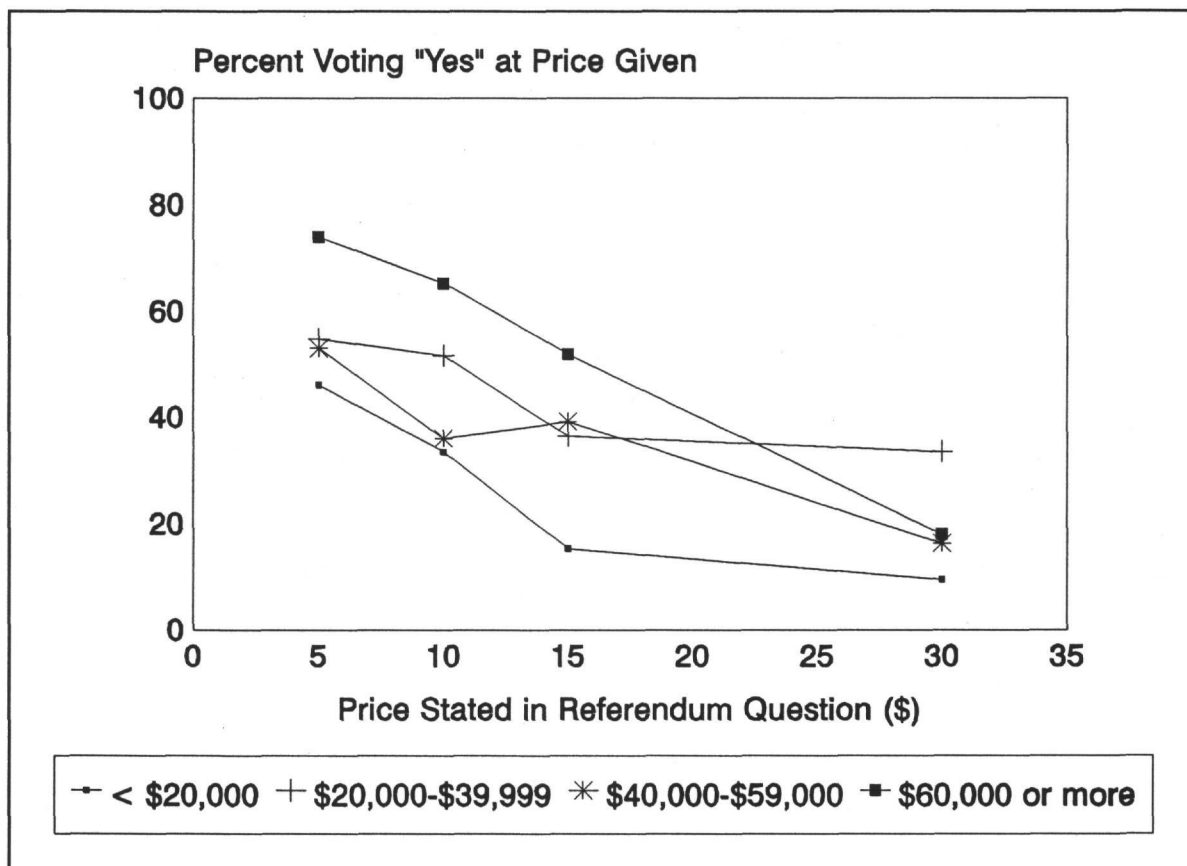
Figure 4.2, below, shows the voting patterns in the pooled results, this time subdivided by educational attainment. For three of the four prices offered, the overall proportion voting "yes" was lower for the "High School Diploma or Less" category (the exception was for the $15 price).

**Figure 4.2:**
**Percent of Respondents Voting "Yes" at Price Offered**
**(by Education Attainment, Pooled Data)**
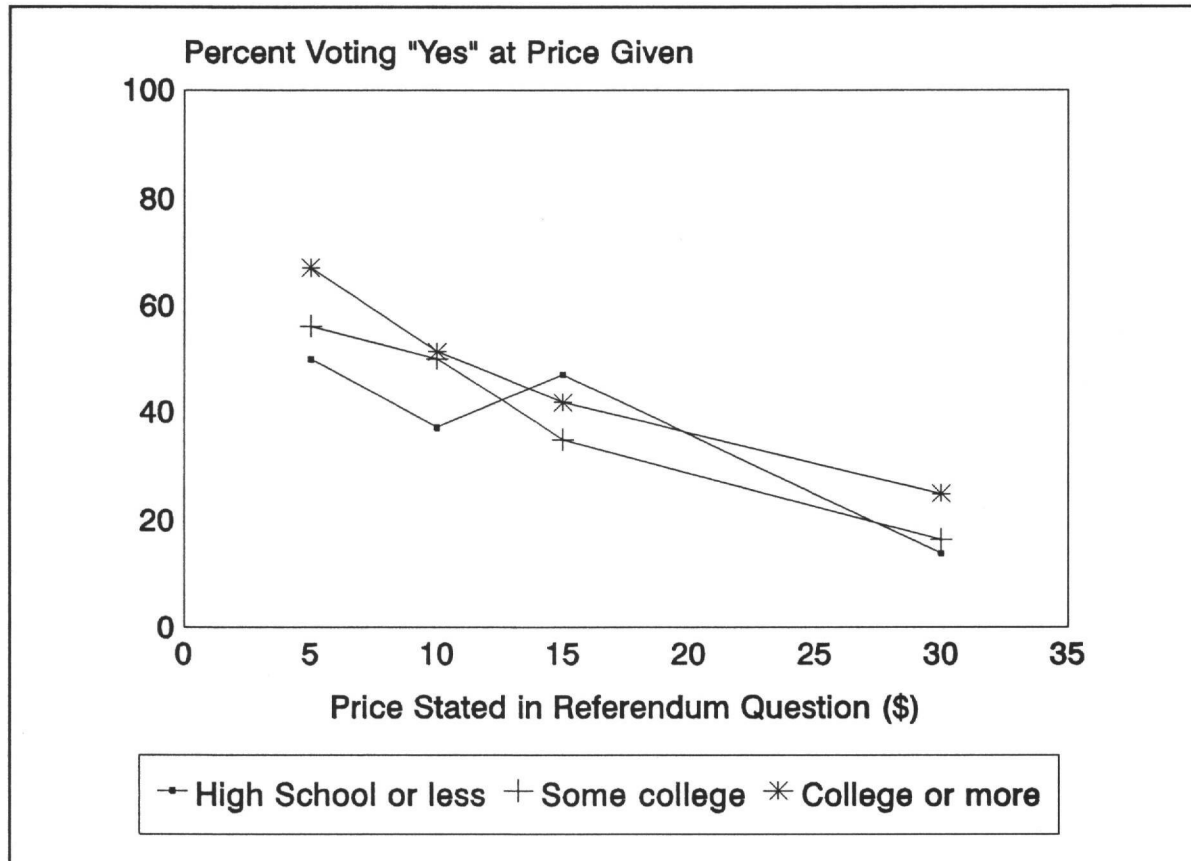
The votes given by recreational users and nonusers of the bay are compared in Figure 4.3. Here a clear trend is apparent. A much higher proportion of respondents that use the bay voted "yes" at each price. The results in this figure include eating seafood from the bay as a use of the bay, and thus the total number of users is much higher than the number of nonusers in this comparison (82 percent versus 18 percent).

**Figure 4.3:**
**Percent of Respondents Voting "Yes" at Price Offered**
**(Comparison of Recreational Users and Nonusers, Pooled Data)**
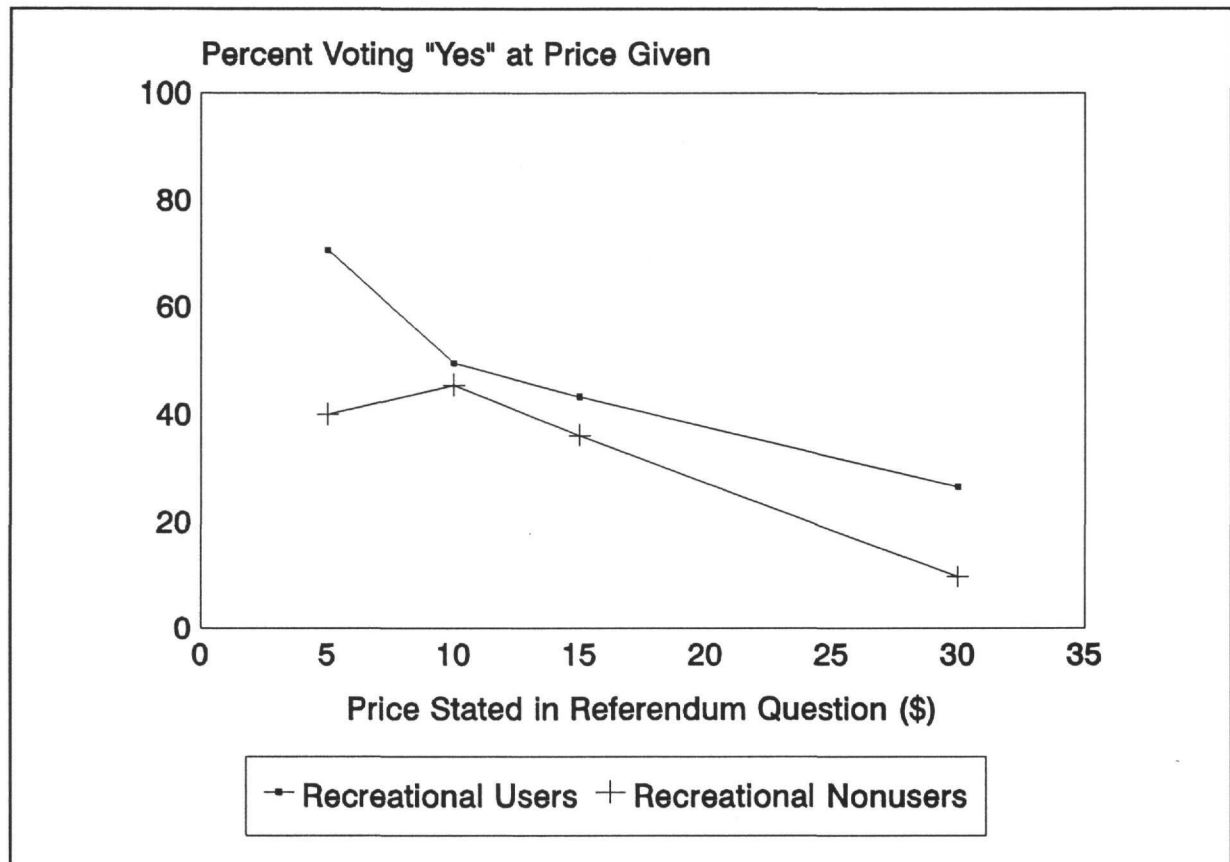


### 4.4.3 The "Not Sure" Response in the Mail-Only Sample

In both the mail/in-person follow-up and the mail-only surveys, some of the respondents replied that they were "not sure" how they would vote in the referendum. The total number giving this "not sure" response for the mail/in-person follow-up sample was only seven. However, the total for the mail-only sample was 112 out of 377 respondents. Figure 4.4 presents the proportion responding "yes," "no," and "not sure" to the referendum question in the mail-only sample. For

each surcharge amount stated in the referendum question, the proportion responding "not sure" was nearly 30 percent, fairly evenly distributed over the prices offered. An interpretation of the high incidence of the "not sure" responses in the mail-only survey is given in Chapter 5, along with the implications of assumptions used to handle these responses.
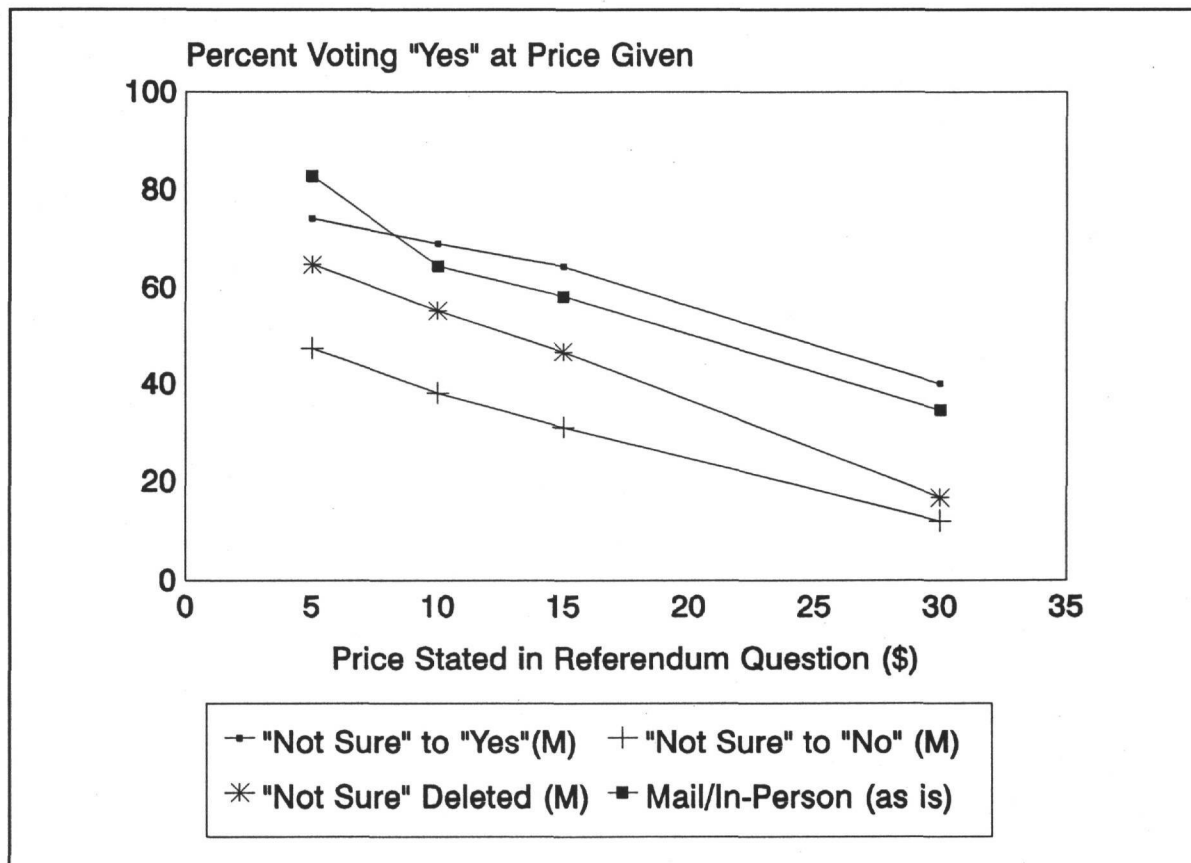
**Figure 4.4:**
**Percent of Respondents Voting "Yes," "No," and "Not Sure" at Price Offered**
**(Mail-Only Survey Alone)**
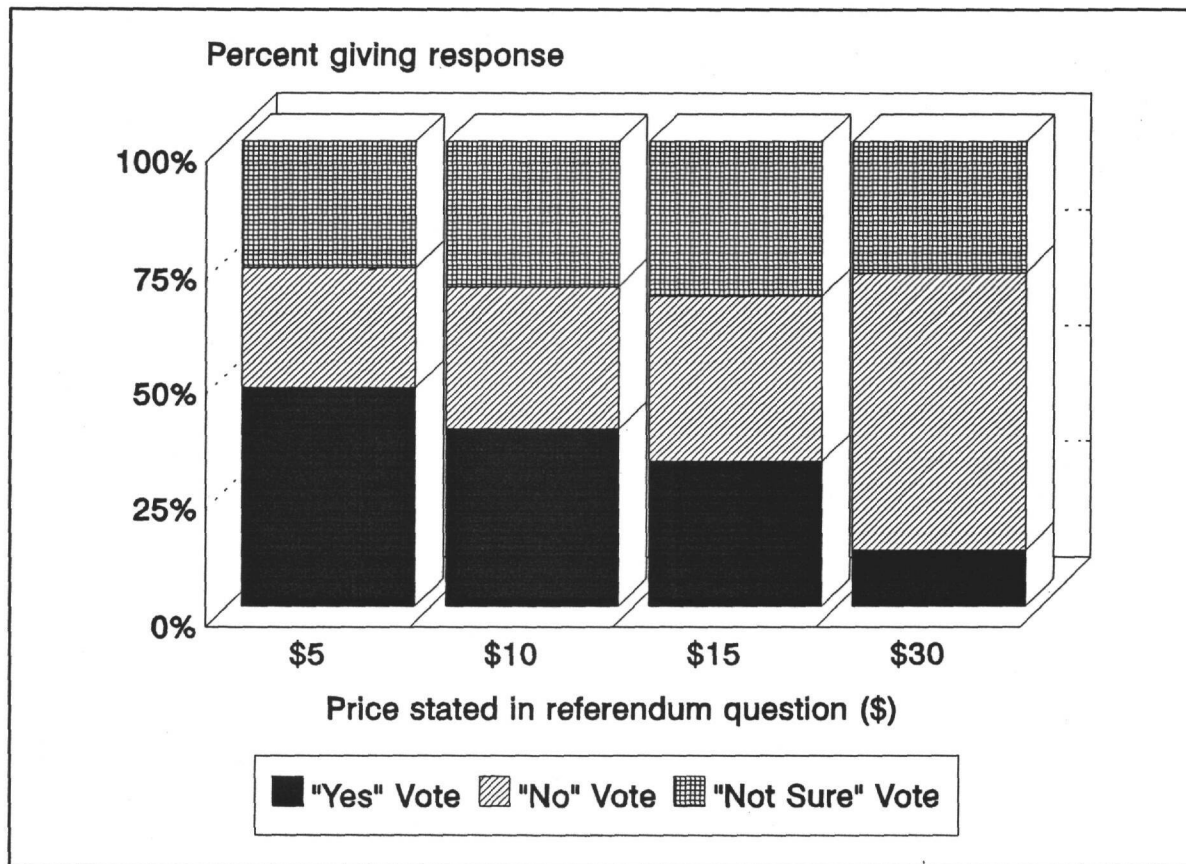


We had three simple options for inferring the true ("yes" or "no") votes of respondents who gave a "not sure" response. We could assume that all were truly "no" responses (Option 1), or that they were all really "yes" responses (Option 2), or we could assume that they were a random occurrence and delete them altogether from our analysis (Option 3). These options will be more fully explored in Chapter 5 but are presented here for insight into the effects that these

assumptions may have on the data to be analyzed.[17]  Figure 4.5 shows the effect of these assumptions on the relationship between the percent of respondents voting "yes" and the price offered in the mail-only sample, and the unadjusted responses for the mail/in-person follow-up sample.[18]

**Figure 4.5:**
**Percent of Respondents Voting "Yes" at Price Offered**
**(by Survey Type and Treatment of "Not Sure" Responses)**



Percent Voting "Yes" at Price Given

Price Stated in Referendum Question ($)

- "Not Sure" to "Yes"(M)    + "Not Sure" to "No" (M)
- ✳ "Not Sure" Deleted (M)    ■ Mail/In-Person (as is)

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[17]    A more complex option is to statistically correct for the "not sure" responses by analyzing them as a non-random selection influence on the valuation results.  Our attempt to make this type of correction is discussed in the next chapter.

[18]    Adjustments were not made here for the "not sure" responses to the mail/in-person follow-up data since only three persons (1.5 percent) in this sample gave this response.

As shown, the unadjusted mail/in-person follow-up results fall between the results of the mail-only referendum assuming that "not sure" means "yes" (Option 2) and the results that exclude the "not sure" responses from the mail-only sample (Option 3). The lower bound corresponds to the assumption that "not sure" means "no" (Option 1).

As a general observation, we can see that the results of the referendum for the mail/in-person follow-up survey showed higher approval of the plan than those of the mail-only survey. One explanation for the difference is that the respondents in the mail/in-person follow-up sample are, on average, located closer to the bay than the whole study population. Note also that a much higher percentage of the participants in the mail/in-person follow-up survey were "serious users" of the bay (i.e., used the bay for recreational fishing or boating more than ten times per year) than in the mail-only survey (see Table 4.6). Other possible explanations for this discrepancy are that respondents in the in-person follow-up interviews may have been trying to please the enumerator by giving what they thought were the "correct" answers, may have felt that a "not sure" response was not acceptable, or might have not wanted to appear indecisive in the interview perhaps in part because they knew they were to receive a $50 payment. "Not sure" respondents in the mail-only survey, however, might have not spent sufficient time thinking about the management plan to come to a reasoned decision about its value to them since a convenient, apparently acceptable "not sure" response was readily available to them.

### 4.4.4 Effect of Video Treatment

From the raw referendum results, it is not clear that watching the video had any effect on responses to the referendum question. Figure 4.6 presents the results for the pooled sample, again combining the mail-only and the mail/in-person follow-up data sets. A slightly larger proportion of the respondents who watched the video voted "yes" at the $10 and $15 prices, but at $5 the proportion of these was less, and at $30 the proportion was the same. The question of whether watching the video had an impact on willingness to pay is investigated more thoroughly in the next chapter.

**Figure 4.6:**
**Percent of Respondents Voting "Yes" at Price Offered**
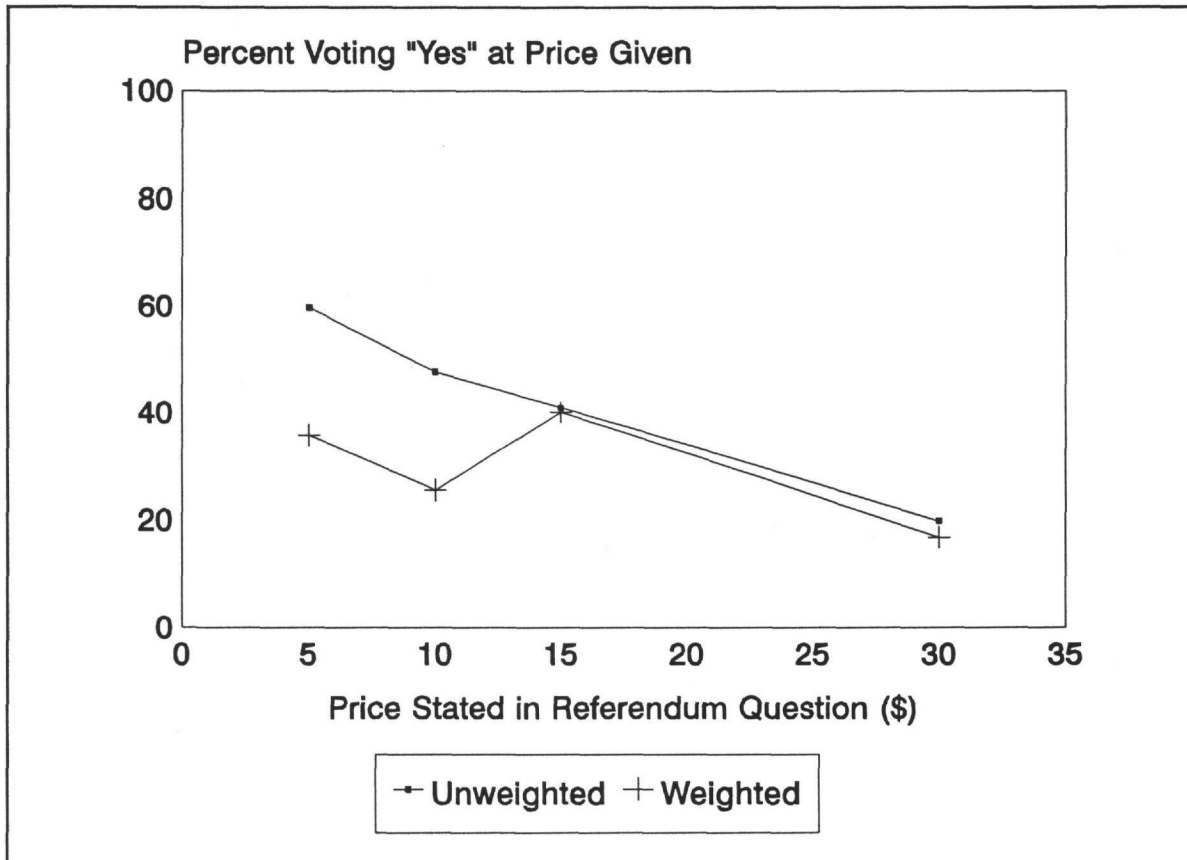**(by Video Treatment, Pooled Data)**
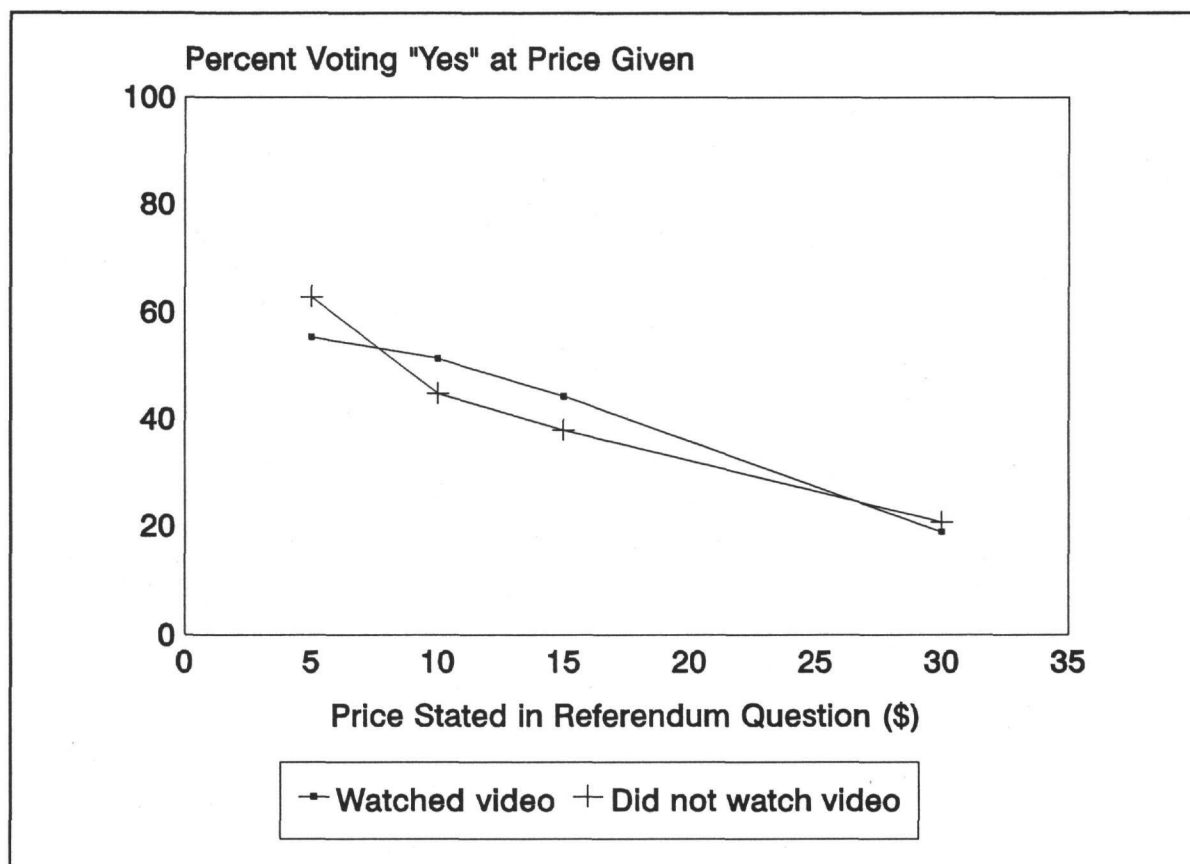
### 4.4.5 Sample Selection Corrections

Despite our efforts to select representative samples of the population in the Greater Houston-Galveston Area, the demographic profile of our final pool of respondents did not match that of the study area population taken from the 1990 census (see Section 4.1., above). To examine the effect of this sample selection bias, we weighted the sample observations by their proportions in the general population using demographic information, and looked at the percent that would be expected to vote "yes" when we pooled the mail-only and mail/in-person follow-up samples.

Figure 4.7 compares the proportion of respondents voting for the plan in both the raw, pooled sample and in the sample that was weighted to reflect the characteristics of the general population of the study area. The weighted responses are uniformly less pro-plan than the unweighted responses, indicating that a valuation arising solely out of our raw results would give an overestimate of the value of the hypothetical management plan. However, the weighting process itself can potentially bias the results in another way: observations from respondents from greatly underrepresented groups may not be representative of that group's sentiments. Often weighted samples are heavily influenced by a very few observations. In Chapter 6 we discuss the weighting procedure and explore in detail the implications of weighted results for our final valuation calculations.

**Figure 4.7:**
**Percent of Respondents Voting "Yes" at Price Offered**
**(Unweighted and Weighted, Pooled Data)**

Percent Voting "Yes" at Price Given



Price Stated in Referendum Question ($)

-•- Unweighted    + Weighted

Blank

# Chapter 5:
## The Factors Determining Households' Willingness to Support a Management Plan for Galveston Bay

## 5.1    Introduction

This chapter examines the factors that determined how respondents answered the valuation questions in the contingent valuation surveys. Multivariate statistical analysis is required to better understand the relationship between a respondent's willingness to support the management plan at a specified monthly price and the characteristics of the respondent and his or her household. In this chapter we describe the theoretical underpinning of our multivariate analysis and present the results. In Chapter 6 we use these results to present estimates of (1) mean respondent household willingness to pay for the plan and (2) the aggregate economic value of the management plan to residents of the Greater Houston-Galveston Area.

## 5.2.    Theoretical Framework of Multivariate Analysis

The models used for our analysis are based on a random utility model (RUM) framework originally formulated by McFadden (1974) and extended by Hanemann (1984) and others. The discussion below outlines the method used to calculate respondents' willingness to pay from discrete choice data. Essentially, the construction employs a dichotomous probit model in which the independent variables explain the probability that a respondent will say yes (VOTE=1) to the referendum question at a specified price. Applying the RUM formulation to the decision to vote yes for the management plan at a specified price, equation (5.1) characterizes an individual's decision as the comparison of the utility under each state (M=with a management plan and stated price, and NM=with no management plan and no change in income). The difference in the respondent's utility under the two states is assumed to determine his or her vote:

$$[(\mu_M(.)+\epsilon_M)-(\mu_{NM}(.)+\epsilon_{NM})] \overset{>}{\underset{<}{=}} 0, \qquad (5.1)$$

where $\mu_i(.)$ is the observable component of the utility function for each state i, and $\epsilon_i$ is the unobserved, stochastic component of the utility function for state i. A positive value of the difference would correspond to a yes vote for the management plan. If we interpret $\mu_i(.)$ as an indirect utility function, we can rewrite equation (5.1) in a linear form to represent the difference in utility between the two states as

$$\alpha_M + \beta_M(y-p) + \theta_M Z - \alpha_{NM} - \beta_{NM}y - \theta_{NM}Z + \epsilon_M - \epsilon_{NM} \overset{>0}{\underset{<0}{=}} 0, \qquad (5.2)$$

where y is household income, p is the monthly price for the management plan given to the respondent in the survey, and $Z$ is a vector of other socioeconomic variables that enter into the utility function. The probit model of the decision to vote for the management plan for Galveston Bay can thus be formulated as:

$$Prob(vote=yes)=Prob(\epsilon_{NM}-\epsilon_M<a+by-cp+dZ), \qquad (5.3)$$

where $a=(\alpha_M - \alpha_{NM})$, $b=\beta_M - \beta_{NM}$, $c=\beta_M$, $d=(\theta_M - \theta_{NM})$.

Using this random utility framework, we can calculate the economic value of the management plan to respondents (in terms of their total willingness to pay [WTP] for the expected outcomes of the management plan). A respondent's total willingness to pay for the management plan is described in terms of the difference between the expected value of his or her utility in the two states. The expected willingness to pay of each respondent is:

$$WTP=\frac{(a+by+dZ)}{c}. \qquad (5.4)$$

This result will be used in Chapter 6 to calculate the mean willingness to pay of households in the Greater Houston-Galveston Area for the management plan described in the survey.

## 5.3. Model Specification

The list of independent variables (p,y,$Z$) used in our multivariate models, along with a brief description of each, is provided in Table 5.1. From the perspective of economic demand theory, the three variables with the clearest expectations of their effects on respondents' answers to the valuation question(s) are: (1) the monthly price of the management plan, (2) household income, and (3) respondent's current recreational use of the bay. We expect that the higher the monthly price, the less likely the household is to vote for the management plan. We also expect that the greater the household's income, the more likely a respondent will be to vote for the management plan at a specified price. Finally, we expect that respondents who use the bay for recreational purposes would be more likely to support the management plan than respondents who do not use the bay.

Three other socioeconomic/demographic explanatory variables are included in the model: the respondent's education level, gender, and race. Economic theory does not offer clear, unambiguous expectations of the effects of any of these variables on the probability that a respondent would support the management plan. One might reasonably expect that more

educated respondents would better understand the ecological functions of Galveston Bay, and thus be more likely to support the management plan. But more education might equally well enable respondents to better understand the economic importance of industries on the Houston Ship Channel to the local economy and the possible negative impact of pollution control regulations on its economic vitality.

**Table 5.1     Independent Variables:  Determinants of Support for the Galveston Bay Management Plan**

| Variable Name | Description | Expected Sign |
|---|---|---|
| PRICE (p) | Price; the monthly payment quoted to the respondent in the referendum question ($5, $10, $15,or $30)[19] | - |
| VIDEO | Dichotomous variable: 1=respondent watched the video; 0=respondent did not watch the video | ? |
| QUESTYPE | Dichotomous variable: 1=respondent participated in the mail/in-person follow-up survey;  0=respondent completed the mail-only survey | ? |
| INCOME (y) | Continuous variable;  household annual income (in $10,000) | + |
| SCHOOL | Continuous variable;  Number of years of school completed by respondent | ? |
| USE | Dichotomous variable:  1=respondent used the bay for recreational purposes at least once in the past 12 months; 0=no recreational use in the past 12 months | + |
| FEMALE | Dichotomous variable:  1=respondent is female; 0=respondent is male | ? |
| WHITE | Dichotomous variable:  1=respondent is Caucasian; 0=respondent is Hispanic, African-American, Asian, or other race/ethnicity | ? |

[19]     In the mail/in-person follow-up survey a second referendum question was asked that allowed us to estimate the proportion of this sample that would have supported the management plan at $2 per month, while in the mail-only survey the lowest referendum price was $5 per month. This lack of a lower referendum price in the mail-only survey increases the uncertainty in our estimates of the mean willingness to pay since the distribution function for responses to the valuation question is not well defined for prices under $5 per month.

Two additional explanatory variables are included in the multivariate model to measure the effect of the two experimental treatments on the likelihood that a respondent would support the management plan. The variable "QUESTYPE" indicates whether or not the respondent received the mail/in-person follow-up survey or the mail-only survey. The variable "VIDEO" indicates whether or not the respondent watched a video that was included in his or her survey materials. Although the NOAA report (NOAA, 1993) advocates that in-person interviews should be used rather than mail surveys and that respondents should be provided with as much information as possible (e.g., a video), we do not have clear expectations as to the direction of the effects of these treatments on the valuation responses.

## 5.4    Adjustments to the Data Set

We made two adjustments to the data set before estimating the model. The first was to impute values for missing responses to the income question. The second concerned the treatment of the "not sure" responses to the referendum question (as noted in Chapter 4, these occurred almost exclusively in the mail-only survey).

### 5.4.1  Imputation for Missing Values:  Income

Our imputation of values for missing data for use in the multivariate model was limited to the variable for household income. The survey instruments included a question that asked respondents to indicate in which of ten categories their household income belonged. The income categories themselves were specified in intervals of $10,000 up to $100,000, with the final category including all respondents whose income was over $100,000. Thirty-seven respondents chose not to answer this question. In accordance with standard practice, we set all missing values of income equal to the median income category of our respondents ($40,000-49,999).

This design of the income question meant that we had to convert the income intervals into a continuous variable for use in the multivariate model. In order to do so, we fitted income data for the Greater Houston-Galveston Area to a log-normal curve and calculated the mean values over each range.[20] The imputed continuous income values are shown in Table 5.2. These

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[20]    In order to convert these interval values for each respondent into point estimates of their actual income, we fit the data to a log-normal distribution and calculated the mean of each range from the area under the fitted curve. Our source of demographic data for the Greater Houston-Galveston Area was the U.S. Census data for 1990 (STF-3 files), which allowed us to calculate the mean income for the five-county study area. However, the standard deviation of the mean and the median incomes for the study area were not available or calculable from these data. In order to fit the curve to a log-normal distribution, at least one of these two pieces of data are required. Since the mean and median incomes for each county alone were available from the census data and since over 80 percent of the study population resides in Harris county, we calculated the standard deviation of income for Harris county as a reasonable estimate of the standard deviation of income for the five-county area.

values were used for the model estimation.

| Table 5.2   Imputed Mean Income of Stated Intervals | |
|---|---|
| Income Interval | Imputed Value |
| $0-$9,999 | $7,376 |
| $10,000-$19,999 | $15,139 |
| $20,000-$29,999 | $24,785 |
| $30,000-$39,999 | $34,709 |
| $40,000-$49,999 | $44,695 |
| $50,000-$59,999 | $54,699 |
| $60,000-$69,999 | $64,709 |
| $70,000-$79,999 | $74,721 |
| $80,000-$89,999 | $84,733 |
| $90,000-$99,999 | $94,745 |
| Over $100,000 | $146,828 |

## 5.4.2  Adjustments for "Not Sure" Responses to the Referendum Question

The high incidence of respondents in the mail-only portion of the study who gave a "not sure" answer to the referendum question is a potentially significant source of bias in the estimation of our valuation function describing the determinants of household support for the management

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Using the mean income for the whole five-county area and our estimate of the standard deviation of this income, we generated a log-normal distribution using the mathematical software program GAUSS. Given this distribution and the fact that there are 1.2 million households in the five-county study area (1990 census), we calculated the number of households in each category and then the mean for each category as follows. First, we took the integral of the distribution, f(y) (where y is income), from the lower limit of each income interval to the upper limit to arrive at the number of households in each income category. Then, we took the integral of (y*f(y) dy) from the lower limit to the upper limit of each income interval to arrive at the total income in the interval. Dividing total income by the total number of households in the interval, we found the mean income for each of the 11 income categories in our survey. Table 5.2 shows the mean income for each range that was imputed to each respondent whose income response fell into that category.

plan.[21] In an actual referendum persons are given the opportunity to vote for or against a proposal. People that are "not sure" can either stay home (i.e., not vote) or they can vote in a random manner. A "not sure" response to the valuation question(s) in our surveys may thus represent someone who would not have voted in an actual referendum. Of course, many of the people who did indicate a preference in our surveys for or against the management plan described might not have voted in an actual referendum.

Our treatment of the respondents who answered "not sure" to our valuation question(s) could significantly affect the parameter values in our model and thus the values we estimated for households' willingness to pay for the management plan. As noted in Chapter 4, we had essentially three options for handling the "not sure" responses: (1) assume that all the respondents that said "not sure" were in fact giving "no" responses; (2) assume that all "not sure" responses were "yes" responses; and (3) delete the "not sure" observations from the data set. Option 1 is the most conservative option, assuming that all those who were "not sure" would vote against the management plan at the monthly price specified. Option 2 is the most liberal and would result in upwardly biased estimates of the value of environmental improvements.

If the "not sure" responses were random occurrences, then dropping these responses from the data set (Option 3) would not introduce any systematic selectivity biases into the remaining sample. To test whether this was true, we estimated a probit model that explained the probability of being decisive (i.e., giving either a "yes" or "no" answer to the valuation ) versus being indecisive (i.e., giving a "not sure" response). The explanatory variables included VIDEO, QUESTYPE, FEMALE, and SCHOOL (described above in Table 5.1).

The results of this probit model are shown in Table 5.3. Questionnaire type is statistically significant and negative, indicating that respondents in the mail-only survey were more apt to say "not sure" than participants in the mail/in-person follow-up survey. The variable denoting the gender of the respondent is also significant, with women being more apt to say they are "not sure" than men.[22] Finally, level of education is negative and highly significant, indicating that

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[21]     As described in Chapter 4, one of the most significant differences between the responses to the valuation questions in the mail/in-person follow-up survey and the mail-only survey was the high incidence of respondents in the mail survey choosing the "not sure" response to the referendum question. Although a "not sure" response was available for respondents of both instruments, it was one of three explicit options (yes, no, not sure) available to the mail-only respondents. The referendum question for the respondents in the mail/in-person follow-up survey was worded in exactly same way as the referendum question for mail-only respondents, but given the nature of an in-person interview, the respondents did not read/see the possible response choices available to them, and their answers were recorded directly by the enumerator onto the follow-up questionnaire. As a result, 30 percent of the mail-only respondents chose the "not sure" response, while only 3 percent of the in-person respondents did so.

[22]     The finding that women were more likely to give a "not sure" response should be interpreted carefully. While it may mean that women were less decisive about supporting the plan than men, it may simply mean that women were being honest and that men were reluctant to admit that they did not know or were unsure about something (even though they might have been uncertain).

respondents with low education are more likely to give a "not sure" response.

**Table 5.3    Multivariate Model Results Describing Decisiveness in Responding to Referendum Questions**

| Variable Name | Parameter Values |
|---|---|
| CONSTANT | -1.230 † |
| | (-2.964) |
| VIDEO | 0.235 + |
| | (1.835) |
| QUESTYPE | 1.534 † |
| | (8.166) |
| FEMALE | -0.316 # |
| | (-2.393) |
| SCHOOL | 0.116 † |
| | (4.245) |
| | |
| Unrestricted log (L) | -259.94 |
| Rest. log (L) | -320.42 |
| Chi-Sq. Stat. | 120.95 |
| Chi-Sq. Sig. | .00000 |
| Pseudo $R^2$ | .19 |
| N | 623 |
| % correctly predicted | 79 |

The numbers in parentheses below the estimated coefficients are the ratio of these coefficients to the estimates of their asymptotic standard errors.
† indicates null hypothesis of b=0 is rejected at a 1% significance level.
# indicates null hypothesis of b=0 is rejected at a 5% significance level.
+ indicates null hypothesis of b=0 is rejected at 10% significance level.

This last finding is consistent with Jon Krosnick's studies (1991) of how respondents behave when confronted with complex analytical tasks. He found that persons with low cognitive sophistication (a trait likely to be correlated with low levels of education) were more apt to "satisfice" by choosing a response that was acceptable but allowed them not to have to carry out the difficult information-processing tasks required to make a decisive judgment. Our surveys certainly required a good deal of information processing and cognitive ability. Therefore, we should not be surprised that respondents with lower motivation and less cognitive ability might experience fatigue in answering our questions. Krosnick's findings serve to emphasize that persons who were indecisive about the management plan were not necessarily against it; they might simply be unwilling or unable to expend the mental effort necessary to make a definitive choice.

Given this finding that the "not sure" responses are systematically related to the education and gender of the respondent, an alternative approach to dropping the "not sure" responses is to make an econometric correction to account for the socioeconomic information available in the interviews that were dropped. We tried to apply this approach, but the economic estimation procedure has proven unstable.[23]

Instead, we decided to estimate the valuation function using both Option 1 and Option 3, and report both sets of results. The model results based on the use of Option 1 will yield a very low bound on mean respondent household willingness to pay for the management plan. We believe that the model results based on the use of Option 3 probably provide the best basis for calculating a reasonable estimate of households' willingness to pay.

## 5.5 Results

Table 5.4 below presents the results of a model with all the explanatory variables ("full" model) and of a model with a reduced number of explanatory variables ("reduced" model). Both the full and reduced models were estimated using both assumptions for handling the "not sure" responses described above (Option 1 and Option 3). There are several noteworthy findings from these model estimation results. First, the three variables with unambiguous theoretical interpretations--PRICE, INCOME, and USE--all have the expected signs and are statistically significant in all four of the estimated models. The price effect is negative: as price increases, respondents are less likely to vote for the management plan. The effect of income is positive: as income increases, respondents are more likely to vote for the plan. Finally, persons who engage in any type of recreational activity on the bay are more likely to vote for the management plan.

Had the results for these three variables been otherwise, there would have been prima facie evidence to question the validity of the contingent valuation exercise. However, these results suggest that respondents did not give random answers to the contingent valuation question; instead their answers are systematically related to the explanatory variables suggested by economic theory.

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[23] The University of North Carolina research team attempted to make an econometric correction for the selection bias introduced by the large percentage of "not sure" responses to the referendum questions in the mail-only questionnaire. We tried to estimate a bivariate probit model with selection effects which is a variation of the Heckman (1979) selection effects correction technique. We believe that this type of full information maximum likelihood estimation is the most appropriate approach to dealing with our selection bias. However, under all specifications we tried, the estimated variance-covariance matrix of our estimates was singular and the model unsolvable. Because we were unable to make this correction, we have carried out a sensitivity analysis of the options for treating the "not sure" responses. These sensitivity analyses define the bounds on the true mean willingness to pay value. Our final estimates, based on deleting the "not sure" responses from the data set, are not ideal but are based upon currently accepted practices in the survey research field.

**Table 5.4    Results of the Multivariate Models of the Determinants of Households' Responses to the Valuation Question**

| | Option 1 ("Not Sure" responses set to "No") | | Option 3 ("Not Sure" responses dropped) | |
|---|---|---|---|---|
| | Full Model | Reduced Model | Full Model | Reduced Model |
| Constant | -1.162 † | -1.265 † | -0.184 | 0.069 |
| | (-2.789) | (-3.156) | (-0.392) | (0.383) |
| PRICE | -0.047 † | -0.047 † | -0.053 † | -0.052 † |
| | (-7.419) | (-7.420) | (-7.824) | (-7.812) |
| INCOME | 0.047 † | 0.049 † | 0.055 † | 0.060 † |
| | (2.815) | (3.020) | (2.939) | (3.501) |
| SCHOOL | 0.059 # | 0.060 # | 0.024 | . |
| | (2.186) | (2.252) | (0.799) | . |
| USE | 0.412 † | 0.411 † | 0.396 † | 0.395 † |
| | (3.553) | (3.548) | (3.115) | (3.118) |
| VIDEO | 0.003 | 0.005 | -0.046 | -0.046 |
| | (0.023) | (0.047) | (-0.381) | (-0.381) |
| QUESTYPE | 0.790 † | 0.785 † | 0.448 † | 0.433 † |
| | (6.869) | (6.845) | (3.602) | (3.559) |
| WHITE | -0.031 | . | -0.085 | . |
| | (-0.213) | . | (-0.532) | . |
| FEMALE | -0.126 | . | -0.036 | . |
| | (-1.037) | . | (-0.266) | . |
| Unrestricted log (L) | -346.77 | -347.32 | -289.12 | -289.94 |
| Rest. log (L) | -414.91 | -414.91 | -339.89 | -340.54 |
| Chi-Sq. Stat. | 136.29 | 135.18 | 101.52 | 101.18 |
| Chi-Sq. Sig. | 0.000 | 0.00 | 0.00 | 0.00 |
| Pseudo $R^2$ | 0.149 | 0.148 | 0.164 | 0.162 |
| N | 610 | 610 | 491 | 492 |
| % correctly predicted | 69 | 69 | 67 | 66 |

The numbers in parentheses below the estimated coefficients are the ratio of these coefficients to the estimates of their asymptotic standard errors.
† indicates null hypothesis of b=0 is rejected at a 1% significance level.
# indicates null hypothesis of b=0 is rejected at a 5% significance level.
+ indicates null hypothesis of b=0 is rejected at 10% significance level.

The explanatory variable characterizing a respondent's education (SCHOOL) had a positive effect for the Option 1 models, but as we have seen, this is because low education levels were correlated with "not sure" responses. When the "not sure" responses are set to "no" (Option

1), respondents with low education levels appear less likely to support the management plan. When the "not sure" responses are dropped from the sample (Option 3), education of the respondent no longer has a statistically significant effect on the probability that the respondent will support the management plan.

The results for the type of survey (QUESTYPE) are unambiguous: respondents in the mail/in-person follow-up survey were more likely to support the plan than respondents in the mail-only survey. Interestingly, whether or not a respondent watched the video did not have any consistent effect on the probability that the respondent would vote for or against the management plan. Nor did the race or gender of the respondent have any effect on the valuation responses.

## 5.6 Conclusions

The model results presented in this chapter do not "prove" that the answers respondents gave to the contingent valuation referendum question are an accurate reflection of how they would vote in a real referendum, or that their answers are an accurate, reliable reflection of their values for improving the environmental quality of Galveston Bay. However, the results are consistent with prior theoretical expectations and, we believe, should increase the reader's confidence that the survey results do contain information about how households value environmental quality improvements.

The results presented in Table 5.4 will be used in the following chapter to calculate the average amount respondents in our sample were willing to pay for the management plan. Then, we will use the results of the reduced models based on Option 3 to calculate total annual economic value that households in the Greater Houston-Galveston Area place on the management plan for Galveston Bay.

# Chapter 6:
## Estimates of the Economic Value of Improvements in the Environmental Quality of Galveston Bay

## 6.1 Introduction

In this chapter we use the results of the multivariate analyses presented in Chapter 5 to estimate the mean household willingness to pay for the management plan for different groups of respondent households in the Greater Houston-Galveston Area. We then use these results to estimate the total willingness to pay of the entire population of Greater Houston-Galveston Area for the implementation of the management plan. This aggregation requires that we account for the fact that our sample respondents were not entirely representative of the area population and that preferences for the management plan may differ between respondents and nonrespondents. We must thus weight the willingness to pay of the various respondents in the data set according to their socioeconomic representation in the five-county study population and perform sensitivity analyses to account for unobserved differences between the respondent and nonrespondent populations. In this chapter we describe how this was done.

## 6.2 Mean Respondent Household Willingness to Pay (Unweighted Sample Only)

The multivariate models presented in Chapter 5 can be used in two different ways to derive estimates of mean respondent household willingness to pay for the management plan. First, we can define a "typical" respondent household and, using average or assumed values for the explanatory variables in the model, calculate the typical respondent household's willingness to pay using equation 5.4. For example, we could use the estimated model to calculate the willingness to pay of a household that uses the bay for recreational purposes and has the mean income and mean education level of households in the Greater Houston-Galveston Area. This approach is most useful for observing the magnitude of the differences in willingness to pay of individuals in different groups of respondent households. For example, we can compare the willingness to pay of a typical respondent household that used the bay for recreational purposes and one that did not, or the willingness to pay of a typical respondent household that watched the video on Galveston Bay and one that did not.

Table 6.1 presents estimates of the willingness to pay of different groups of respondent households using this method. All of the estimates assume that the "typical" respondent household had the same education and income level as the average household in the Greater Houston-Galveston Area (based on 1990 U.S. Census data). Table 6.1 presents these estimates under each of the two assumptions employed for the treatment of the "not sure" responses that were discussed in Chapter 5 (Option 1 and Option 3). Table 6.1 shows the significance of these assumptions: the mean values of willingness to pay are substantially higher if the "not sure" responses are dropped from the sample. We will focus our remaining discussion in this chapter

on results for Option 3, which we consider "better" estimates of willingness to pay than those for Option 1, for the reasons explained in Chapter 5.

**Table 6.1   Comparison of Valuation Differences Under Both Treatments for Users and Nonusers (Typical\* Respondent Household, Monthly Willingness to Pay)**

| Category | Option 1: "Not Sure" to "No" | Option 3: "Not Sure" deleted |
|---|---|---|
| Mail/In-person follow-up | | |
| Users with video | $19.61 | $21.04 |
| Users with no video | $19.49 | $21.92 |
| Nonusers with video | $10.85 | $13.48 |
| Nonusers with no video | $10.74 | $14.36 |
| Mail-only | | |
| Users with video | $ 2.87 | $12.75 |
| Users with no video | $ 2.76 | $13.63 |
| Nonusers with video | ($5.89) | $ 5.18 |
| Nonusers with no video | ($6.00) | $ 6.07 |

\* Income and education variables have been set at mean values for persons in the Greater Houston-Galveston Area to allow for direct comparison between groups.

The results in Table 6.1 show that if a typical respondent household participated in the mail/in-person follow-up survey, it would give a substantially higher mean willingness to pay ($21 for users; $13 for nonusers) than if it participated in the mail-only survey ($13 for users; $5 for nonusers). The results from the mail/in-person follow-up survey and the mail-only survey cannot both be correct: reliable estimates of willingness to pay should not depend on which type of survey instrument the respondent received. We cannot be sure which of the two sets of estimates is most accurate, so we present both. However, we believe that it is prudent to be conservative, and so we would advise that the results from the mail-only survey be given greater emphasis.

The results in Table 6.1 suggest that the typical respondent household that uses the bay for recreational purposes is willing to pay 60-100 percent more per month than a similar respondent household that does not use the bay. For the mail/in-person follow-up survey, the typical user was willing to pay about $21 per month versus $13 per month for the typical nonuser. In the mail-only survey, the comparable estimates are $13 versus $5-6. Many analysts have suggested that including "passive use" or "existence" values in estimates of the economic value of

environmental improvements will greatly inflate the estimates, and that such nonuse values will overwhelm or dominate more traditional estimates of use value. These estimates suggest otherwise. In fact, the relative values of environmental quality improvements to the bay for users and nonusers seem quite reasonable.

The fact that receiving the video did not affect respondents' willingness to pay in either the mail/in-person follow-up survey or the mail-only survey is significant because this finding suggests that people's willingness to pay for environmental quality improvements in Galveston Bay may not be easily changed by public education campaigns or by receiving more information about the bay. However, it may be that those who did participate in the survey did so because they already knew something about the condition of the bay. Those who did not participate might still benefit from additional information.

A second approach to calculating mean household willingness to pay is to use equation 5.4 to calculate the willingness to pay of each individual in the sample, and then take an average of these values. In other words, we take the income and education that each respondent reported, and whether or not his or her household used the bay, and substitute these values into equation 5.4. This gives an estimated willingness to pay for that single household in the sample. We repeat this calculation for every household in the sample and then calculate the mean willingness to pay of all sample households. Table 6.2 presents the results of these calculations for both the mail/in-person follow-up and mail-only respondents, and for the two options for handling the "not sure" responses.

**Table 6.2**    **Unweighted Mean Respondent Willingness to Pay for Galveston Bay Management Plan By Questionnaire Type and Options for Accommodating "Not Sure" Responses**

| Questionnaire Type | Option 1 | Option 3 |
|---|---|---|
| Mail/in-person follow-up | $19.75 (n=233) | $20.44 (n=227) |
| Mail-only | $3.36 (n=390) | $12.24 (n=281) |

The mean willingness-to-pay values in Table 6.2 are similar in magnitude to those using the first approach. For those respondents participating in the mail/in-person follow-up survey, the mean household willingness to pay was $20; for households participating in the mail-only survey, the mean willingness to pay was $12. In interpreting the results in Table 6.2, it is important to keep in mind two points. First, the socioeconomic characteristics of the two samples (i.e., the households that participated in the mail/in-person follow-up survey and those that participated

in the mail-only survey) were not exactly the same (see Table 6.3). Second, these estimates are not accurate reflections of the mean willingness to pay of households in the Greater Houston-Galveston Area because we have not taken account of the fact that our sample respondents were more highly educated and had higher incomes than the typical household in the area. In addition respondents may have been motivated to participate by their interest in or concern for the issue, and nonrespondents may well have values considerably less than respondents.

## 6.3. Mean Respondent Household Willingness to Pay (Using Sample Weights)

As noted, the respondents who actually completed the surveys had higher incomes, were better educated, and were less likely to be Hispanic or African-American than the overall population of the Greater Houston-Galveston Area as reflected in the 1990 census. Residents with less than eight years of education were severely underrepresented. Our sample did not include any observations of individuals with less than an eighth-grade education who were of a racial/ethnic origin other than Caucasian, African-American, or Hispanic (approximately 1 percent of the five-county area population). Table 6.3 shows the extent of this sample selection bias in terms of selected socioeconomic characteristics for the mail/in-person follow-up and mail-only surveys, under both options for handling "not sure" responses.

**Table 6.3**   **Comparison of In-Person and Mail-Only Survey Respondents With Houston Area Profile (1990 Census) Showing Effect of Option 1 and Option 3 on Demographic Make-up of Sample**

|  | Mail/ In-person Whole Sample (Option 1) | Mail/ In-person Reduced Sample (Option 3) | Mail-Only Whole Sample (Option 1) | Mail-Only Reduced Sample (Option 3) | Greater Houston-Galveston Area Profile |
|---|---|---|---|---|---|
| Number of Respondents | 234 | 227 | 393 | 281 | 3.3 mill. |
| Mean Age of Respondent | 47.6 | 47.3 | 48.3 | 48.0 | 40.7 |
| % Male/% Female | 66/34 | 66/34 | 68/32 | 73/27 | 50/50 |
| Mean Household Size | 2.49 | 2.5 | 2.69 | 2.6 | 2.75 |
| Mean Number of Children in Household | 0.60 | 0.60 | 0.63 | .56 | 0.785 |
| Education of Respondent |  |  |  |  |  |
| % Through High School Only | 24.90 | 23.9 | 21.0 | 18.0 | 49.3 |
| % With Some College Only | 36.50 | 36.3 | 29.5 | 28.1 | 26.6 |
| % Completed College/More | 38.60 | 39.8 | 49.5 | 54.0 | 24.0 |
| Mean Income | $55,095 | $55,720 | $54,817 | $56,443 | $41,064 |
| Median Income | $44,695 | $44,695 | $44,695 | $44,695 | N/A |
| % Homeowners/Renters | 77/23 | 77/23 | 84/16 | 86/14 | 54/46 |
| Mean House Value (Home-owners Only) | $64,704 | $64,224 | $82,279 | $82,316 | N/A |

| Mean Rent (Renters Only) | $471 | $471 | $416 | $429 | N/A |
|---|---|---|---|---|---|
| Racial Breakdown | | | | | |
| % Caucasian | 81.1 | 81.0 | 84.3 | 85.7 | 56.87 |
| % African-American | 11.2 | 11.1 | 6.5 | 5.5 | 18.2 |
| % Hispanic | 6.4 | 6.6 | 4.5 | 4.0 | 21.0 |

To correct for this sample bias, we first assumed that the responses of those who did participate in either the mail-only or mail/in-person follow-up survey accurately reflect the attitudes and values of others in their socioeconomic group, at least up to the proportion of the population that responded to each survey type. We then used the 1990 Census data to tabulate percentages of the study-area population by race and educational attainment, and calculated weights based upon these relative proportions.[24] The weights were calculated using inverse proportions, where

$$\text{Weight}_i = \frac{\text{(Proportion of study area population in socioeconomic group}_i)}{\text{(Proportion of respondent population in socioeconomic group}_i)}$$

We then used the second approach described in the previous section for calculating mean household willingness to pay, substituting each households' characteristics into the valuation function. In this case, however, we also multiplied the estimated willingness to pay for each household by the corresponding weight assigned to the household according to the race and education of the respondent. We then calculated the mean of these weighted values. Because the weights on the observations for underrepresented groups were large (in some cases greater than 5), the results can be substantially affected by the valuation responses of a very few individuals in these underrepresented groups. We used two approaches for dealing with this problem:

(1)     Simply presenting the weighted results and cautioning the reader that they may be sensitive to a few individuals' answers;

(2)     Deleting the highly weighted observations. (This assumption might be justified on the grounds that we learned very little about the value that underrepresented groups place on improving the environmental quality of Galveston Bay.)

The results of the calculation of mean respondent household economic value for both approaches are presented in Table 6.4 for Option 3. As shown, if the highly weighted observations are included, the result of weighting the sample responses is to reduce the mean household willingness to pay for both the mail/in-person follow-up survey (from $20 to $19) and for the mail-only survey (from $12 to $10). If the highly weighted observations are deleted, the result of weighting the sample responses is to leave the mean household willingness to pay essentially unchanged from the unweighted means for both the mail/in-person follow-up survey and for the

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[24]     Since education and income are correlated, we used schooling as a proxy for overall socioeconomic status in the calculation of the sample weights.

mail-only survey. This shows that the effect on the mean value calculation of our correction for underrepresented groups is not great.

**Table 6.4     Weighted Mean Monthly Respondent Willingness to Pay for the Hypothetical Galveston Bay Management Plan By Questionnaire Type and Options for Treating Heavily Weighted Observations (Using Option 3 Treatment of "Not Sure" Responses)**

| Questionnaire Type | Weighted Mean Monthly WTP (Heavily Weighted Observations Included) | Weighted Mean Monthly WTP (Heavily Weighted Observations Deleted) |
|---|---|---|
| Mail/in-person follow-up | $19.02 | $19.92 |
| Mail-only | $10.45 | $11.51 |

## 6.4 Estimates of Aggregate Annual Willingness to Pay for the Greater Houston-Galveston Area

The calculation of aggregate willingness to pay estimates for the Greater Houston-Galveston Area required two steps. We first determined an equivalent annual mean respondent household willingness to pay by discounting the monthly estimate by a 4 percent annual rate over twelve months. The per-household annual figures are presented in Table 6.5 for Option 3. As shown, the estimates of mean annual willingness to pay per respondent household for the hypothetical management plan fall in the range of $123-235 depending on the assumption made about the representativeness of highly weighted observations for underrepresented groups and the type of survey used.

**Table 6.5     Weighted Mean Annual Willingness to Pay Per Respondent Household By Questionnaire Type and Options for Treating Heavily Weighted Observations\* (Option 3 Only)**

| Questionnaire Type | Weighted Mean Annual WTP (Heavily Weighted Observations Included) | Weighted Mean Annual WTP (Heavily Weighted Observations Deleted) |
|---|---|---|
| Mail/In-person follow-up | $224 | $235 |
| Mail-only | $123 | $136 |

\* Monthly estimated mean willingness to pay, discounted at 4 percent per year.

Each cell in Table 6.5 is calculated for a slightly different subset of the study area population. Since Option 3 is the underlying assumption for all cells, the respondents who answered "not sure" were deleted from the data set for all calculations. Removing these observations from the mail-only survey increased the number of socioeconomic categories for which there were zero respondents from one to three. The number of unrepresented socioeconomic categories in the mail/in-person follow-up survey remained unchanged at six. Some socioeconomic categories (i.e., Caucasian residents with less than eight years of schooling) had several respondents but were poorly represented relative to the proportion of this category in the population of the study area as a whole (i.e., Caucasians with less than eight years of schooling were 0.5 percent of the mail-only sample compared with 10.7 percent of the 1990 study area census population). Thus, these observations for under-represented groups were heavily weighted (weights greater than 5). If we assume that these observations reflect the behavior and attitudes of at least the proportion of the population represented by each survey type, we can still use these observations in our calculation of the aggregate willingness to pay. This is the assumption made in calculations shown in the first column of Tables 6.4 through 6.6.

On the other hand, if we assume that the heavily weighted observations are not sufficient to represent their respective groups and we drop these observations from the data set as well, the total number of respondent households to be included for aggregation decreases. In the second column of Tables 6.4 and 6.5, we calculate estimates of value only for the respondent population that is sufficiently well represented.

The second step in aggregating our sample responses to the general population was to multiply the weighted mean annual values by the number of households in the Greater Houston-Galveston Area that were represented by the respondents from each survey type. The 1990 U.S. Census reports the total number of households in the study area as being 1,198,973; we have used this figure as a basis for our calculations. To simply aggregate to the whole population assumes that the values that nonrespondents place on an improvement to the bay is equivalent to respondents' values. However, respondents may well have cared more about the bay than nonrespondents. To accommodate the possible differences in preferences between the respondent and nonrespondent populations, the research team conducted a sensitivity analysis using three different assumptions about the nonrespondents:

    (1)    that they had the same values as respondents;

    (2)    that they placed one half the value on environmental improvements as respondents; and

    (3)    they placed no value on environmental improvements.

The results of these calculations of aggregate annual economic value are presented in Table 6.6.

**Table 6.6    Aggregated Mean Annual Willingness to Pay (in $ Million per Year) by Questionnaire Type, Options for Treating Heavily Weighted Observations, and Assumptions About Nonrespondents' Values (Option 3 Only)**

| Questionnaire Type | Assumption about the Value Nonrespondents Place on the Management Plan* | Heavily Weighted Observations Included | Heavily Weighted Observations Deleted |
|---|---|---|---|
| Mail/in-person follow-up | 100% | $269 million/yr. | $282 million/yr. |
| | 50% | $188 million/yr. | $197 million/yr. |
| | 0% | $107 million/yr. | $111 million/yr. |
| Mail-only | 100% | $147 million/yr. | $163 million/yr. |
| | 50% | $100 million/yr. | $109 million/yr. |
| | 0% | $ 52 million/yr. | $ 57 million/yr. |

* Nonrespondent's values calculated as a percent of the mean respondent value.

Our estimate of the range of aggregate value for the hypothetical management plan for Galveston Bay is $100-250 million per year. This range is based upon the assumptions that the "not sure" responses can be dropped from the sample and a sensitivity analysis of nonrespondents' values. We believe the mail/in-person follow-up aggregate values should be viewed as a reasonable upper bound given the high proportion of recreational users of the bay in this sample. In addition, we believe that assigning a zero value for all nonrespondents is too conservative and hence recommend that the range of values used for nonrespondents be 50-100% of respondents' values. In our judgement, the mail-only results provide the more conservative, defensible aggregate value for the plan.

# Chapter 7:
## Summary and Conclusions

*I know of no safe depository of the ultimate powers of the society but the people themselves, and if we think them not enlightened enough to exercise that control with a wholesome discretion, the remedy is not to take it from them, but to inform their discretion.*

*--Thomas Jefferson, letter, 1820*

In this report and the accompanying appendices, we have presented a range of estimates of the economic value of improving the environmental quality of Galveston Bay. These estimates must be interpreted judiciously. Our primary focus has been on estimates of economic value based on the data collected in the contingent valuation survey. There are four major reasons that these estimates must be considered uncertain.

First, the physical and ecological consequences of the management plan described to respondents are uncertain. Ideally we would have been able to confidently predict the outcomes of the management plan and describe them to respondents in sufficient detail "to inform their discretion." However, because the physical, hydrological, and ecological systems in Galveston Bay are not well understood, respondents themselves had to assess the likely consequences of the management plan and value them as best they could. If they assumed that the management plan would not do much to clean up the bay, then our contingent valuation survey would not capture what they would be willing to pay for a major or significant improvement in environmental quality.

In fact, most of our respondents did say that they believed that the components of the management plan would be effective in improving environmental quality, but we were not able to assure respondents of a specified set of environmental outcomes. Although our inability to specify the environmental outcomes of the management plan is a limitation in terms of our estimates of economic value, it is the situation that people would actually face in a real referendum. In this sense the uncertain outcome of the management plan is not a limitation of the contingent valuation survey in terms of predicting how people in the Greater Houston-Galveston Area are likely to vote if given the opportunity.

Second, the estimates of economic value based on the contingent valuation survey assume that respondents gave truthful, honest answers to the valuation questions: i.e., that their answers to hypothetical survey questions are accurate reflections of their true preferences for environmental quality improvements in Galveston Bay. The multivariate analyses of the contingent valuation responses presented in Chapter 5 show clearly that people's answers are not random, but rather are systematically related to respondents' socioeconomic characteristics and use of the bay in the way one would expect. In other words, we found that high-income respondents were willing to pay more than low-income respondents, that users of the bay were willing to pay more than

nonusers, and that people in general were less likely to vote for the management plan when they were given a higher price (i.e., monthly surcharge).

These results suggest that respondents paid attention to the questions being asked and increase our confidence in the quality of the information obtained. They are not, however, evidence that respondents' answers to hypothetical questions are good predictors of how they would actually vote in a real referendum. As with any public opinion poll, there is the possibility that respondents misrepresented their answers in order to influence the results of the study, or misinterpreted the questions that were asked.

The reader will have to make his or her own assessment of the confidence that can be placed in the answers to the valuation questions. We want to emphasize, however, that we do not believe there was any obvious reason why respondents would want to misrepresent their preferences for the management plan. Our personal judgment, based on over two hundred in-person interviews, is that the vast majority of these respondents thought carefully about their answers to the valuation questions and, to the best of their ability, gave honest answers.

The most worrisome finding regarding the accuracy and reliability of the contingent valuation results is the significant difference in household willingness to pay between the mail/in-person follow-up survey and the mail-only survey. Our analysis suggests that a typical household that received the mail/in-person follow-up survey was willing to pay approximately 60 percent more than if it had received the mail-only survey ($21 per month versus $13 per month). One plausible explanation for this difference is that in the in-person interviews respondents sought to please the enumerators, and were more likely to vote for the management plan because they felt that this is what the enumerators wanted to hear. This is, however, only speculation. There has been very little other empirical work examining the effect of in-person versus mail interview formats on respondents' answers to contingent valuation questions. In our survey respondents who took part in the in-person interviews were specifically and pointedly told that there were no right or wrong answers to the valuation questions, that people had different and valid reasons for voting for and against the management plan, and that the enumerator wanted to record what they really thought. At the end of the questionnaire we asked respondents whether they felt that the questions had been biased in any way; 80 percent said that the questions were not biased. Nevertheless, the difference in the results of the mail/in-person follow-up and mail-only surveys introduce an additional element of uncertainty into our estimates of economic value because we do not know which set of results is the most accurate.

Third, a series of econometric and analytical procedures were used to calculate estimates of economic value from respondents' answers to the referendum question. These procedures require that additional assumptions be made. As described in Chapters 5 and 6, the treatment of the "not sure" responses to the mail-only questionnaire has a large effect on the estimates of economic value. The fact that we do not know how these respondents would have actually voted in a real referendum--or if they would have voted at all--adds another element of uncertainty. Similarly, our assumptions regarding the construction of the weights used to aggregate our estimates of households' economic value to the population of the entire Greater Houston-

Galveston Area affect our results somewhat.

Fourth, even if respondents gave accurate answers to the valuation questions, their preferences for environmental quality improvements in Galveston Bay may change. They may not have thought carefully about how much they would be willing to pay for cleaning up Galveston Bay. If there were an extended public debate on this issue, some people might change their mind on how they would vote (of course, they could change their mind in either direction). In other words, people's preferences may be unstable and amenable to persuasion. Yankelovich (1991) makes a distinction between mass opinion and public judgment. Before members of the public have carefully considered an issue, public opinion polls often reveal internal contradictions in mass opinion and unstable results that can be influenced by changes in the wording of questions. However, once an issue has been carefully thought through by the public, Yankelovich finds their opinions are quite stable and not easily manipulated by pollsters. He describes this process as "coming to public judgment" on an issue.

Many environmental and ecological experts believe that the average citizen does not have a sufficient understanding of systems ecology to fully appreciate the benefits of improving the environmental quality of an estuary system such as Galveston Bay. They thus believe that people's values based on a contingent valuation survey are only a reflection of their ecological ignorance and are of little use for thoughtful policy deliberations. Some environmentalists and ecologists may feel, as Thomas Jefferson described in the above quotation, that people have to be educated with regard to the value of such environmental improvements whereas others may believe that such decisions are best left in the hands of experts. In Yankelovich's terms, these environmentalists may believe that the public has not reached a reasoned judgment about how much to invest in the clean-up of Galveston Bay, and that it may be unlikely that they ever will.

We do not know whether respondents have reached such a public judgment about the benefits of cleaning up Galveston Bay, and this introduces another source of uncertainty into our estimates of the economic value of cleaning up the bay. It is possible that our estimates of economic value could change during the course of a broad public debate and/or education campaign. The high percentage of respondents who gave a "not sure" response in the mail-only survey lends some support to the argument that many people in the Greater Houston-Galveston Area may be uncertain about the economic value of cleaning up Galveston Bay.

On the other hand, we would caution against drawing the conclusion that public education campaigns can easily generate much higher levels of support for the management plan, and thus higher estimates of economic value. This is because we provided respondents in our contingent valuation survey with a considerable amount of information--more than most people are likely to obtain in a public debate--and we gave many of them time to read and reflect upon these materials. In fact, almost two thirds of the respondents in the mail/in-person follow-up survey said that they had discussed the information in the questionnaire with other family members or

their neighbors. Moreover, almost half of our respondents watched the video.[25] Respondents who watched the video did not answer differently than those who did not receive it.[26]

Most respondents described themselves as sympathetic to environmental concerns, and slightly less than half already used the bay for recreational purposes.[27] Almost 60 percent of the respondents agreed with the statement "Protection of the environment should not be sacrificed for jobs."[28] The vast majority (90 percent) of the respondents reported that they had been exposed to information from the media over the last year about pollution in Galveston Bay; about 40 percent estimated that they had received such information five times or more. All of this evidence suggests to us that providing the public with more information on Galveston Bay is not likely to lead to significantly greater support for the management plan.

A related reason why it may prove difficult to increase support for the management plan is that people generally do not feel responsible for the environmental problems of Galveston Bay. All respondents were asked a direct question about whether their own household affected Galveston Bay: two thirds said that their household's activities did not have a negative impact on the bay. In response to a question about whether they felt a responsibility to pay for a management plan, almost two thirds of the respondents said that they did not feel very responsible.

Table 7.1 provides a summary of the sources of uncertainty that affected our results, along with what was done to preempt or counteract their effects, and implications for the study results. In spite of these major sources of uncertainty, our estimates of the economic value of the management plan appear to us to be quite reasonable. Based on the results of the mail-only survey, the average household in the Greater Houston-Galveston Area is estimated to be willing to pay approximately $7 per month for the management plan described in the questionnaire, assuming that nonrespondent households value the proposed plan at one half that of respondents. This is about $80 per year for five years.

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[25] Almost 90 percent of the respondents who received a video watched it.

[26] In the mail/in-person follow-up survey, we asked respondents who watched the video whether in fact they felt it had changed their vote for or against the management plan. Seventy-five percent of these respondents reported that it had not affected their willingness to pay for the plan.

[27] Only about 5 percent reported that they were unsympathetic to environmental causes.

[28] Only about 10 percent agreed with the statement "Creating and protecting jobs is more important than preserving the environment." Over 20 percent indicated that they were "not sure."

| Table 7.1 | Uncertainties, Assumptions, and Implications for Contingent Valuation (CV) Results Galveston Bay Study |||
|---|---|---|---|
| **I.** | **Source of Uncertainty: Commodity Uncertainty** |||
| Problems || Assumption/Preemptory Actions | Implications for Study Results |
| 1. | What precisely was to be valued? Problem of unknown/dynamic baseline. | Research team described changes in the environmental quality that had occurred in Galveston Bay over the last couple of decades and the probable condition of the bay if no plan were to be adopted. | Both the baseline conditions and the future state of the bay in the absence of management actions were left subject to interpretation by the respondent. Different respondents may have had different expectations about what would happen to the environmental quality in the bay in the absence of a management plan. The estimates of economic value obtained from the CV survey may have been based on different environmental baselines and assumed future conditions. |
| 2. | Unspecified plan components: Management plan (CCMP) for Galveston Bay was not yet developed at the time of the CV survey. | The research team used Galveston Bay National Estuary Program draft proposals and other National Estuary Program draft management plans to define a hypothetical management plan for the CV survey. | If the actual plan differs significantly from the one set forth in the CV study, the estimates of the economic value of improving the environmental quality of the bay may not apply to the actual plan. Respondents' answers to the valuation questions in the CV might have been different if they had been presented with the actual GBNEP plan. |
| 3. | Unknown outcomes of management plan; limited scientific understanding of bay processes. | Respondents were informed that consequences of the plan were uncertain. The CV survey collected information on respondents' perception of the likely effectiveness of the plan. | Same as Implication for 1 above. |

| Table 7.1 | Uncertainties, Assumptions, and Implications for Contingent Valuation Results (Continued) Galveston Bay Study | |
|---|---|---|
| **II.** Source of Uncertainty: Measurement Uncertainty | | |
| Problems | Assumption/Preemptory Actions | Implications for Study Results |
| 1. Unfamiliar purchase exercise, preferences for commodity might not be well formed. | The research team provided all respondents with a brochure about the bay and the proposed management plan. In addition, an experiment was conducted to see if respondents that received more information (in the form of a video) answered questions differently than respondents who did not receive this additional information. | Respondents who watched the video on conflicting uses of Galveston Bay did not value improvements in the bay's environmental quality any differently than respondents who did not watch the video. However, respondents who watched the video were more likely to be decisive and either vote for or against the management plan than were respondents who did not watch the video. How the "not sure" responses are treated in the econometric analysis has a significant effect on the final estimates of economic value. |
| 2. Strategic misrepresentation, free riding behaviors; protest "no's" (e.g., whether a respondent felt it was someone else's responsibility to pay for cleaning up the bay); payment vehicle objections (taxes, user fees, all pay). | The research team asked respondents how they would vote on a public referendum on the management plan described if it entailed a specified monthly surcharge on their water bill. This "referendum format" is considered to be the elicitation procedure least susceptible to strategic bias. In addition, attitudinal questions probing respondents' reasons for their answers were collected and correlated with valuation responses to check for internal consistency. The research team also conducted two different types of interviews (mail/in-person follow-up and mail-only) in order to see how robust respondents' answers were with respect to interview format. | The probability that respondents would vote for the management plan decreased as the monthly surcharge increased. This increases one's confidence in the results of the contingent valuation survey. However, respondents in the in-person interviews answered quite differently from respondents in the mail-only survey. The UNC-CH team based its estimates of improving the environmental quality of Galveston Bay on the lower of the estimates (the mail-only survey results). This conservative approach may *underestimate* the economic value of environmental quality improvements. (Continued on next page) |

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| Table 7.1 | Uncertainties, Assumptions, and Implications for Contingent Valuation Results (Continued) Galveston Bay Study | |
|---|---|---|
| **II.** | **Source of Uncertainty:** **Measurement Uncertainty** (Continued) | |
| Problems | Assumption/Preemptory Actions | Implications for Study Results |
| 3.   Commodity is uncertain (outcomes unknown, success of actions unknown); researchers could not provide a well-defined good. | See Assumptions/Preemptory Actions for 2 and 3 under Commodity Uncertainty, above. | Respondents' answers to the valuation questions in the CV might have been different if they had been presented with the actual GBNEP plan and if the outcomes of such a plan were known with certainty. |

| Table 7.1 | Uncertainties, Assumptions, and Implications for Contingent Valuation Results (Continued) Galveston Bay Study | |
|---|---|---|
| **III. Source of Uncertainty: Population Uncertainty** | | |
| Problems | Assumption/Preemptory Actions | Implications for Study Results |
| 1. Sample of respondents was not representative of the population of the Greater Houston-Galveston Area.<br>a. Overrepresentation of Caucasian, well-educated, male, bay users;<br>b. Underrepresentation of low educated persons, African-Americans, Hispanics;<br>c. Nonrespondents: what should be assumed about their values? | 2 Anticipating a possible sample selection bias, the study team provided $50 for respondents to participate in the mail/in-person follow up interview, and sampled carefully for racial and socioeconomic representation.<br><br>Nonetheless, the respondents were demographically skewed. The research team used an econometric "weighting" procedure to adjust the study results to better reflect the socioeconomic and racial composition of the Greater Houston-Galveston Area. This was achieved by more heavily weighting the few African-American and Hispanic respondents, as well as lower-income and lower-educated respondents of all races, and down-weighting the overrepresented groups.<br><br>Moreover, respondents may well have cared more about the bay than nonrespondents. For non-respondents, the research team conducted a sensitivity analysis using three different assumptions:<br>a. that they had the same values as respondents;<br>b. that they placed one half the value on environmental improvements as respondents; and<br>c. they placed no value on environmental improvements. | The assumptions used to characterize the vales of nonrespondents significantly influence estimates of total economic value. The bounds introduced by the sensitivity analysis are large.<br><br>(Continued on next page) |

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| Table 7.1 | Uncertainties, Assumptions, and Implications for Contingent Valuation Results (Continued) Galveston Bay Study | |
|---|---|---|
| **III.    Source of Uncertainty:  Population Uncertainty** (Continued) | | |
| Problems | Assumption/Preemptory Actions | Implications for Study Results |
| 2.    Study area does not correspond to the actual "extent of the market." | The study area was specified by Galveston Bay National Estuary Program to include only the 5-county area surrounding the bay. | In addition to many of the other conservative assumptions made in the analysis, considerable undervaluation of the resource will probably result because the "extent of the market" for the study was limited to the 5-county area immediately surrounding the bay. The benefits accruing to recreational users living outside the 5-county area are probably considerable.  In addition, the benefits to the nation due to nonuse values for protection of wildlife habitats may be considerable if considered at a state, region, or nation-wide scale. |

Respondents in the survey were also asked why they were willing to pay for a management plan for Galveston Bay. Their answers were revealing. The typical user of the bay was willing to pay substantially more than the average nonusers (about $7.50 per month more). However, the typical nonuser was still willing to pay about $5 per month for the implementation of the management plan. This is largely because of a desire to pass on a healthy environment to future generations. Over 90 percent of the respondents felt that reducing water pollution in the bay was important, and of these people, almost 60 percent said that the most important reason for reducing water pollution was so future generations could use and enjoy the bay. In the mail/in-person follow-up survey, respondents who voted for the management plan (at either the first or second price offered) were asked whether they would still be willing to pay for the management plan if they moved away from the Greater Houston-Galveston Area (perhaps for a job transfer). More than a third said that they would still be willing to pay for the management plan even if they moved away from the area.

One interesting way of considering the results of the contingent valuation survey is to view them as a public opinion poll, and to ask whether a referendum on a management plan for improving the environmental quality of Galveston Bay would actually pass. In our judgment, the results suggest that a slight majority of the population of the Greater Houston-Galveston Area would vote for a plan that increased their water bill by $5 per month for five years. If such a referendum did pass, a $5 surcharge on households' water bills would raise about $60 million per year for the management plan's initiatives. We believe there would be broad public support across all groups in the population for a surcharge in the range of $1-2 per month (surcharges at this level would raise $10-25 million per year).[29]

In addition to supplying the data for our calculations of the economic value of implementing the management plan, the contingent valuation survey provided an extensive set of information on the use of Galveston Bay by residents of the Greater Houston-Galveston Area and on their attitudes and perceptions of the bay. These data show that a small percentage of our (mail-only) sample used the bay extensively as a site for recreational fishing, boating, picnicking, bird-watching, or hiking. Approximately 19 percent of the sample respondents used the bay for such recreational purposes more than ten times per year. Approximately 26 percent of the population of the five-county area used the bay for recreational boating and fishing at least once a year. (Table 7.2 summarizes the number of households estimated to use the bay for different recreation purposes).

However, for the majority of people in the Greater Houston-Galveston Area, Galveston Bay is simply not perceived as a site for recreational activities. Most of our respondents had a negative perception of the quality of Galveston Bay. Only about 18 percent felt that the quality of

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[29]     Of the 234 respondents in the mail/in-person follow-up survey, 61 respondents received the lowest price (i.e., monthly surcharge) of $5 per month. Thirteen of the 61 respondents indicated that they would vote against the plan at this price. These 13 respondents were then asked whether they would support the plan if it cost $2 per month. Of these 13 respondents, 6 said they would vote for the management plan at $2 per month. Thus, 88 percent of the original 61 respondents would have voted for the management plan at $2 per month.

Galveston Bay had improved over the last five years. More than a third thought it was getting worse. Almost 20 percent did not know. Even so, we estimate that Galveston Bay is used by residents of the Greater Houston-Galveston Area for recreational purposes over 7 million times per year (i.e., 7 million "user-days"). This number would certainly increase if the environmental quality of the bay improved.
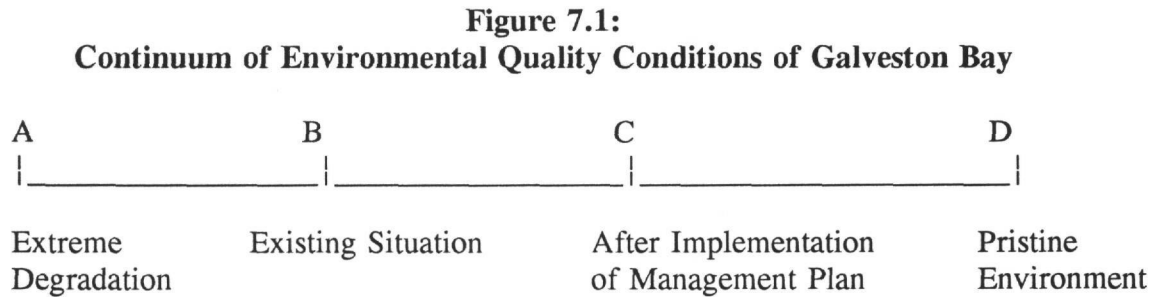
**Table 7.2    Estimated Number of Greater Houston-Galveston Area Households that Use Galveston Bay for Recreational Purposes at Least Once a Year**

| Type of Primary Recreational Use | Percent of Households | Estimated Number of Households in the Greater Houston-Galveston Area Using the Bay |
|---|---|---|
| 1. Fishing only (from a boat or shore) | 16% | 200,000 |
| 2. Boating only (not including fishing from a boat) | 4% | 50,000 |
| 3. Fishing and boating (i.e., households that do both) | 6% | 75,000 |
| Total (fishing and boating) | 21% | 325,000 |
| Households using the bay for other recreational Activities (hiking, picnicking, camping, hunting, swimming, bird-watching, etc., not including fishing or boating) | 18% | 200,000 |
| Households using the bay for any type of recreational activity | 44% | 525,000 |

Most people in our sample do eat seafood from the bay a few times a year, and in this sense have a direct interest in cleaning up the bay. But only about 10 percent reported eating seafood

from the bay as often as three times a month.

Table 7.3 summarizes our estimates of the aggregate annual economic value of improvements in the environmental quality of Galveston Bay to people living in the Greater Houston-Galveston Area. Several aspects of these estimates require explanation. The range of estimated aggregate annual economic benefits from implementing the management plan, $100-150 million, is a conservative estimate based on respondents' answers to the referendum question in the mail-only survey. Consider again the following figure (presented in Chapter 1) :

**Figure 7.1:**
**Continuum of Environmental Quality Conditions of Galveston Bay**

| A | B | C | D |
|---|---|---|---|
| Extreme Degradation | Existing Situation | After Implementation of Management Plan | Pristine Environment |

If this estimate of the economic value of implementing the management plan measures the value of the change from current conditions to an improved environmental quality (C - B), then an estimate of the value of a change in environmental quality from C to A could be obtained by adding this estimate, say $100 million, to an estimate of the economic value of the change (B - A).

One way to measure the value of the change (B - A) is to estimate the losses that households would incur from such a severe deterioration in the environmental quality of the bay. The economic value of losses from a decline in both recreational uses of the bay and commercial fishing would be a lower bound on the value of this change (B - A). Estimates of the economic value obtained from the current level of recreational fishing and boating in the bay are derived in Appendix 1 and are presented in the lower half of Table 7.3.

These calculations use two types of data: (1) estimates from the contingent valuation survey of the number of days people in the Greater Houston-Galveston Area use the bay for these purposes, and (2) previously developed estimates of the economic value of a day spent boating or fishing from other locations in the United States. Many careful studies of the economic value of recreation days spent fishing and boating have been done elsewhere, and the order of magnitude of such estimates is well established (see Appendix 1). The range of estimates in the lower half of Table 7.3 results from different assumptions about the number of days the population of the Greater Houston-Galveston Area spend on recreational activities on or around Galveston Bay, and different assumptions about the economic value of a recreation day for

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different activities.

As shown in Appendix 1, the total annual economic value of the existing level of recreational fishing to users of the bay living in the Greater Houston-Galveston Area is estimated to be in the range of $75-150 million. The total annual value of the existing level of boating to users of the bay who live in the Greater Houston-Galveston Area is estimated to be in the range of $25-50 million. The annual economic value of other recreational uses of the bay to people living in the Greater Houston-Galveston Area is estimated to be in the range of $15-50 million. The total annual economic value of Galveston Bay for recreational uses is thus in the range of $115-250 million.

The estimate in Table 7.3 of the economic value of fish harvested in the bay by commercial fisherman ($1-2 million) is very low in relation to the economic value of recreational uses. This estimate of the economic value of commercial fishing is not the total market value of fish harvested in the bay, but is rather the estimated profit of commercial fisherman, after subtracting their costs from their revenues (see Appendix 1).[30] It is important to note, however, that this is likely to be somewhat of an underestimate of what commercial fisherman stand to lose if the water quality of Galveston Bay deteriorated to such an extent that no fish could be harvested in the bay. This is because such a decrease in the water quality in Galveston Bay would also damage fish nurseries and the productivity of the food chain that supports fish currently caught in the Gulf of Mexico.

Adding the estimate of the annual economic value that would result from the implementation of the management plan (from the contingent valuation survey) to these estimates of the value of existing recreational uses and commercial fishing results in a total annual economic value in the range of $215-400 million. In order not to imply that this range is more accurate than it really is, we suggest rounding to a range of $200-400 million. This suggests that cleaning up the bay instead of letting its environmental quality deteriorate completely is worth on the order of $170-330 per year to each household in the Greater Houston-Galveston Area.

However, if the survey respondents imagined that the existing situation would deteriorate dramatically in the absence of the management plan, adding these estimates together in this manner would result in substantial double counting of economic benefits.[31] This is because in this case respondents in the household survey would have already considered the losses in recreational fishing, boating, and commercial fishing that would result if the management plan were not implemented when they answered the questions in the survey. If this were the case, our range for the annual economic value of Galveston Bay would be on the order of $100-200 million. This would lower the estimate of the economic benefit of cleaning up the bay to $80

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[30] This estimate does not include benefits to secondary industries that rely on commercial fish catch for their profits. Such indirect benefits are, however, likely to be small.

[31] Respondents were told that if the management plan were not implemented, the environmental quality of Galveston Bay would probably deteriorate, in part because wetlands were being lost (see Chapter 3).

to $170 per year for every household in the area.

Finally, it is important to emphasize that the estimates in Table 7.3 refer to the economic value of the bay to residents of the Greater Houston-Galveston Area, not to people living elsewhere in Texas or other states. In fact, many people from outside the five-county area use the bay for recreational purposes, and even people living elsewhere in Texas and the U.S. who do not use the bay for recreational purposes may still be willing to pay to improve its quality. In this sense, the estimated ranges in Table 7.3 present a lower bound on the total economic value of the bay.

Galveston Bay provides several other services that we did not attempt to value in this research effort. These include waste assimilation and erosion control. The assimilative capacity of the bay is used to dilute and dissipate industrial and municipal wastewater and excess heat (through process cooling).[32] The bay is also valuable to many business because it provides an essential transportation artery for the regional economy. However, because the economic value of the bay for transportation uses would not be adversely affected by any of the actions under consideration in the Galveston Bay management plan, we considered it beyond the scope of our research to estimate the economic value of the bay for transportation purposes.

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[32] Waste assimilation is clearly one of the current uses of the bay. It is important to note, however, that increasing the use of the bay for waste assimilation would decrease the value of the bay for other uses (most notably recreational uses). Correspondingly, improvements in water quality would require decreased use of the bay for waste assimilation, and thus lower the economic value of the bay for assimilative uses.

**Table 7.3    Estimates of the Annual Economic Value of Changes in the Environmental Quality of Galveston Bay (1993 Dollars)**

| | Valuation Method Used | | |
| --- | --- | --- | --- |
| Change in Environmental Quality | Contingent Valuation | Benefit Transfer | Net Revenue Analysis |
| 1.  Due to Implementation of the Management Plan: (Use and nonuse values) | $100-150 million/yr. | | |
| 2.  Losses Incurred if the Existing Environmental Quality Deteriorated Greatly: (Use values) | | | |
| Recreational | | | |
| Fishing | | $75-150 million/yr. | |
| Boating | | $25-50 million/yr. | |
| Other (hiking, picnicking, camping, hunting, swimming, bird-watching, etc.) | | $15-50 million/yr. | |
| Commercial fishing | | | $1-2 million/yr. |

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